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SPRING 2015

WORKSHOP PROJECTS AND TECHNIQUES

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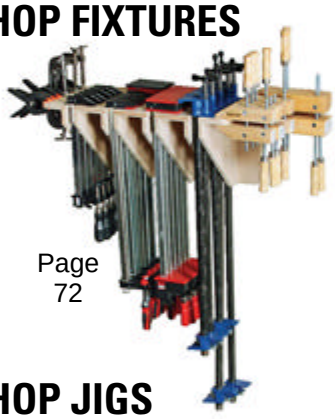

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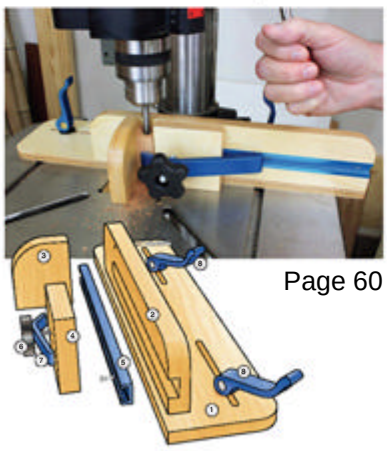

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Power Tools that will Grow with You

THE REAL VALUE OF POWER TOOLS IS HOW WELL THEY CONTINUE TO MEET YOUR NEEDS. HERE'S SOME TOOL-BUYING ADVICE FOR BOTH TODAY AND THE LONG HAUL.

All of us want good value from our tool purchases — high quality for reasonable dollars spent. Then there's the matter of choosing between all the model options available at various price points. Picking the right one is enough to stymie a woodworking editor, let alone a newbie buying those first tools.

After years of reviewing tools for the *Journal*, I still haven't found the tool-buying crystal ball that guarantees you'll find the perfect tools to fit your needs. But, poring over and using hundreds of different tools has left me with some general impressions that may help ease your long-term buying decisions when those times come.

First, a little advice that may surprise you. The "best" tool often isn't the biggest or most expensive. It's the one that gives you safe, accurate results, saves you time or effort and is comfortable to use. Pricing doesn't necessarily correlate with these three factors. You can do fine woodworking with moderately priced tools if they're made well. And, thankfully, the big tool makers we've come to trust are building quality tools at many price points — not just at the top end.

A hybrid table saw can offer many of the features of a cabinet saw at a more reasonable price. It's a good option for the serious hobbyist's shop.

Table Saws

In my book, there's no debating that a table saw is woodworking's workhorse power tool. I use it on every project I build for ripping and crosscutting stock. It's also ideal for cutting rabbets, dadoes, grooves and tenons.

But, here's the clincher: unless you're planning to make a living woodworking, you probably don't need a cabinet saw. It may be overkill. Truth is, a premium contractor's or hybrid saw with a cast-iron table will do the job in a serious hobbyist's shop. Focus on these features and you'll be good to go: your saw should have a rock-solid rip fence that stays put when you lock it down and is easy to square up. For longevity and heavy cutting, you'll want a 1½ to 2hp induction-style motor. It'll have plenty of gusto for slicing thick stock or plowing dadoes. And, if you've got the floorspace, buy the longest extension table package offered for your saw model. You'll never regret 30 or more inches of side table when you need to rip sheet goods or support long stock. Make that extra table length work even harder by converting it into a router table.

All new saws have a true riving knife that moves with the blade. It's your best defense against kickbacks and a much better design than the old-style fixed splitter. Those "hot dog" blade brakes on SawStop saws really work to keep all ten of your digits where they belong. Expensive, yes, but worth the money when compared to surgery, lost wages and painful rehabilitation.

There aren't too many table saw accessories you absolutely need, but a high quality combination blade is a must. It will ensure crisp, accurate cuts with minimal tearout. Buy a stacked dado set too, to mill flat-bottomed rabbets and dadoes.

Add-ons and features that improve saw accuracy, safety

If your table saw's miter gauge leaves something to be desired, consider buying a precision aftermarket miter gauge with preset detents and micro-adjustability.

A true riving knife maintains the same position, relative to the blade, at any cutting height. It's an excellent way to safeguard against kickback. It's a mandated safety feature now, replacing the former fixed-splitter style.

SawStop's blade brake system is proving itself in both home and professional woodshops. It senses skin contact with the blade and stops it in a fraction of a second.

Combination kits are the "Dynamic Duo" of routing these days. You get both fixed and plunge bases with an interchangeable motor pack: exceptional value for all-around routing.

And finally, don't underestimate the importance of dust collection on a table saw. Saws with lower shrouds that surround the blade allow a dust collector to grab the debris right at the source so it doesn't coat your nasal passages.

Routers & Router Tables

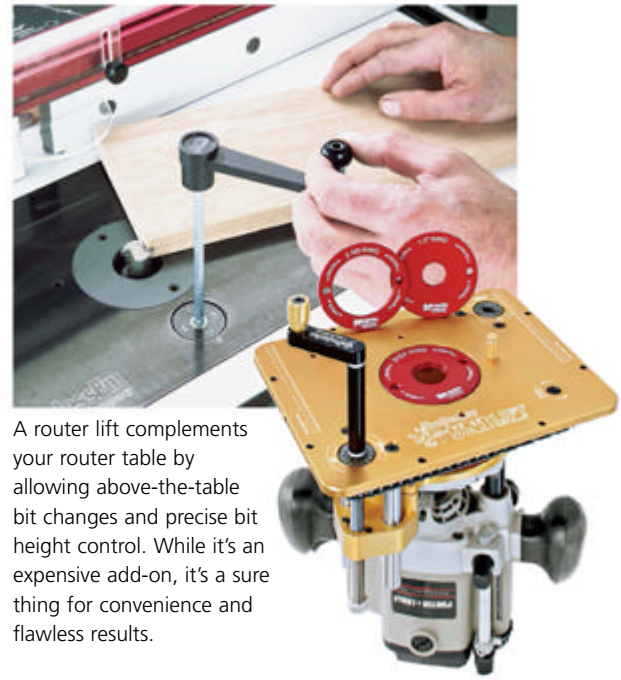
For edge profiling, mortising, template work and joinery, routers are invaluable shop tools. But, you don't need one of every size. Think hard about the work you do now and plan to do years from now. If you have no real plans to make wide custom molding or raise panels for cabinet doors, a huge 3hp router may be more heft and cost than you need. Instead, buy a 1½ to 2½hp combo kit with a motor that fits in both a fixed and a plunge base. These two-base kits are top-notch, in my experience, and their aggregate cost is less than what you'll spend buying individual machines. Mount the fixed-base in your router table and use the other one for handheld work.

Here's what to look for in a quality router: variable-speed control with electronic feedback that maintains bit speed under load. Make sure the plunge base moves smoothly up and down with depth-setting controls that are easy to comprehend. You'll appreciate subbases that accept standard 1¾₁₆"-diameter rub collars, and a sturdy edge guide is always a plus.

A router table is vital to my woodworking. The ability to feed wood past the bit instead of guiding the tool over it is helpful for milling small or narrow parts. A router table is the only safe way to raise panels with those monstrous-sized bits. And, I like the added control offered by a stout, easy-to-adjust router table fence when milling rabbets, dadoes and mortises.

Do you need to buy a prefabricated router table? Certainly not, although some excellent systems are out there. If you're on a tight budget, build your own custom table from a good set of plans. Then, save up for a router lift. A mechanical lift will give you above-the-table bit changing ease,

Whether you build or buy a router table, it's a must-have upgrade that converts your handheld router into a respectable stationary tool. Here's the ticket to advanced joinery, panel-raising and heavy profiling jobs.



A router lift complements your router table by allowing above-the-table bit changes and precise bit height control. While it's an expensive add-on, it's a sure thing for convenience and flawless results.

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plus the ability to micro-adjust your bit height. Make sure your lift can accommodate a 3hp router in the event you ever decide to step up to heavier cutting operations down the road.

Drill Presses

A drill press probably won't be one of the first big tools you buy, but it's surprisingly versatile and worth keeping in your long-range investment plans. It's designed to bore perfectly straight stopped or through holes ... a nearly impossible feat to do by hand.

Clamp a fence to your drill press table, and it's tailor-made for repetitive drilling tasks. With a set of plug cutters, you can fabricate grain-matched plugs to hide screws. A set of sanding drums converts it from drilling to shaping and smoothing in a heartbeat.

Before I bought a dedicated mortising machine, my drill press chomped mortises on a regular basis with a couple Forstner bits. Although I've never timed it, my fancy mortiser doesn't seem to do the job much faster than my old drill-and-chop method.

A drill press doesn't need a burly motor, provided your bits are sharp. What's more important is that it has a table large enough to support your work properly. The bigger the table, the better. Check for flat edges underneath the casting; you'll need these spots for installing clamps. The chuck should be easy to tighten and accept 1/2"-shank bits.

Most drill presses have pulley clusters for changing speeds — and speed control is more important than folks realize. Big bits should be operated at slower speeds than small bits. They'll eject chips more effectively and be safer to operate. Generally, you'll have to move a set of drive belts between the different pulley sizes to change speeds, but some models have electronic variable speed. It's awfully handy and will keep your fingers free of that messy drive belt rubber grime.

When the time comes to buy a drill press, you'll probably wrestle with the choice of benchtop versus floor-standing machines. Here's what to keep in mind: A full-size drill press will provide a bigger motor, large table and more clearance between the column and chuck for wider workpieces. However, if a drill press seems like an occasional-use tool, save your money and buy a benchtop machine. Most can be had for the price of a top-end drill/driver, which seems astonishing for a stationary tool. Yet, you can still drill large holes, cut mortises and drum sand all with a little 1/3 or 1/2hp machine.

Both floor-standing and benchtop drill presses can grow with you if you select a machine with a generous table size, a rugged depth stop system and a simple way to change pulley/belt speeds.

Maximizing Your Drill Press Potential

A drill press does more than just drill holes. It also makes a fine mortiser (above) and can switch over to spindle sanding with a set of sanding drums (left).

Variable-speed control, available on some new full-size and benchtop drill presses, takes the fuss out of speed changing. There's no need to touch a belt when switching bit sizes anymore.

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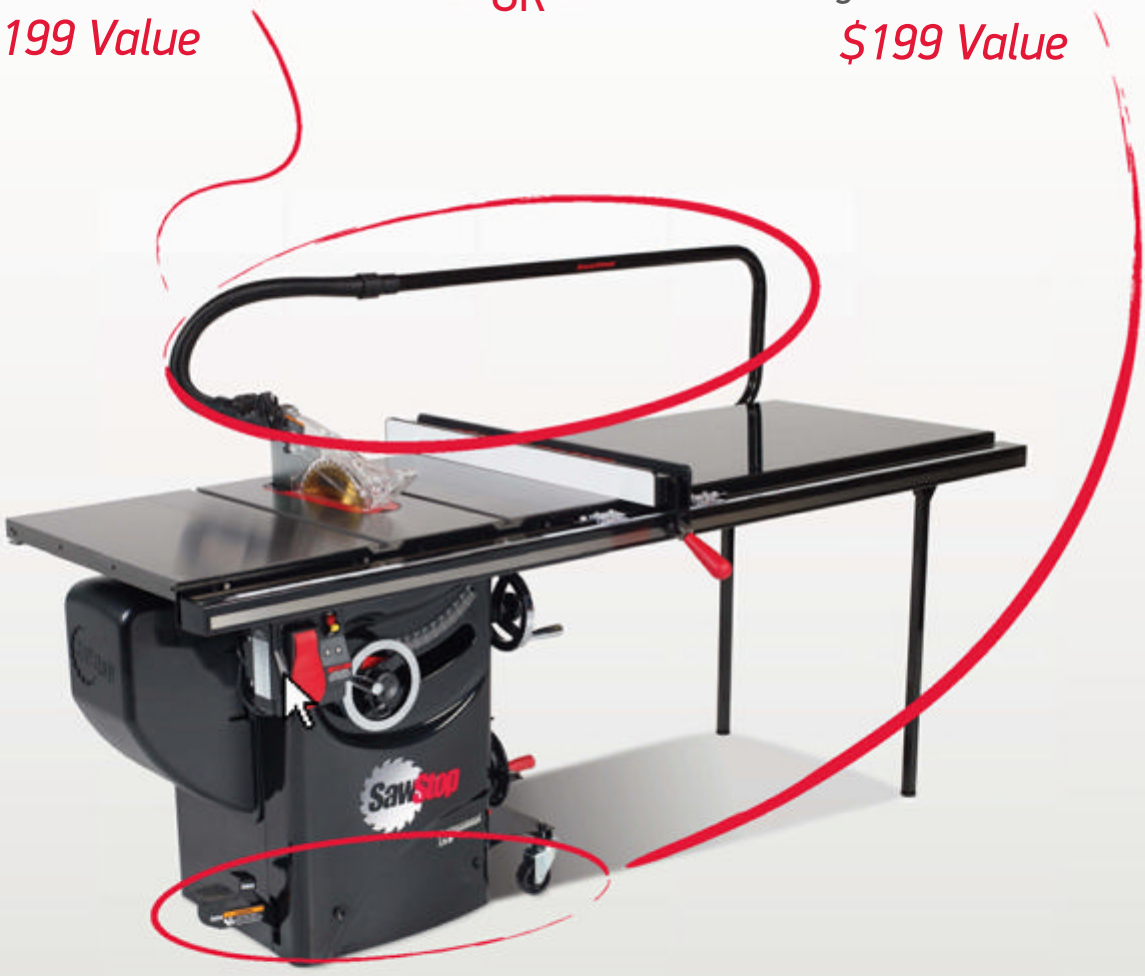

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*Overarm Dust Collection requires a DC Blade Guard, which is included with the 3.0HP Professional Cabinet Saw but must be purchased for the 1.75HP model.

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A jointer and planer give you more control over the initial cost, species options and, of course, final trueness and thickness of your stock. For serious woodworking, you're going to need them both.

Jointers and Planers

No one feels the brunt of wood distortion more than a woodworker without a jointer and planer. Even if your lumber is flat as a pancake when you buy it, there's no guarantee it will stay that way over time or especially when you rip it to width. As long as wood grows on trees, it's gonna distort.

Without the benefit of these fundamental surfacing machines, you have two recourses for salvaging unruly lumber: flattening and truing with hand planes or applying brute force to bend things to your will. The former takes skill and the latter: bad idea.

Sure, a joiner and planer constitute a big chunk of change, but keep an open mind about the benefits. For one, you'll be able to purchase roughsawn stock more economically and from a much wider variety of sources when you can surface it yourself. Second, you'll finally be able to take control over material thickness. If 1/2" door panels or a 7/8" desk top is what you need, crank your planer there and go to it. But most importantly, you'll be able to start each project with truly flat, square and uniform stock ... and that benefit means better accuracy.

Although it might be tempting to buy just one of these two tools, surfacing is a two-machine operation. A jointer flattens faces and edges, while a planer creates a parallel face and reduces stock thickness. There's no overlap in function ... you need both.

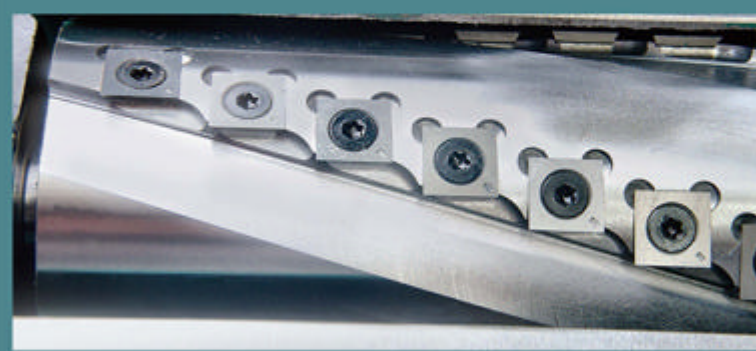
For a home shop, a 6" jointer will offer about 45" to 60" of table length. It's adequate for smaller projects, but I suggest saving up and investing in an 8" machine. The extra table length sure makes long or thick lumber easier to handle, and I find that the wider cutterhead seems just right for average-width stock. Concerning cutterhead styles, I've used both conventional-knife and carbide-insert cutterheads. I much prefer the insert style: you'll never sweat over finicky knife setting, and the inserts cut as smoothly as knives but with less machine noise.

As for planers, I'm impressed with today's 12" to 13½" benchtop models. Their power, accuracy and capacity make them excellent values for the money. Buy one with a cutterhead lock and two speeds. The faster speed is great for initial thicknessing, and the slower "finish" setting will help you tame figured or gnarly grain with less tearout. There are benchtop planers with insert-style cutterheads as well as disposable, self-indexing knives. Either works well. Of course larger industrial-quality planers are tempting, too, but very expensive. Buy a dust collector for your planer. You'll need it! Then, use it to gobble up debris from the jointer, table saw and router table, too.

Band Saws

No other shop tool can match a band saw's curve-cutting prowess. Whether you're sawing delicate inlays, curvy arm leans or roughing logs into turning blanks, a band saw can handle the job with

Say Good-Bye to Knife-Setting Hassles



When purchasing a new jointer or planer, one consideration you'll need to make is ease of knife adjustment. Today's auto-indexing insert cutterheads offer excellent performance with no maintenance headache.

Once you equip your shop with a band saw, you'll wonder how you ever got along without one. The archetypal 14" band saw is a true workhorse in home shops across the country.

equal grace. It's a much safer ripping tool than your table saw, because there's no risk of kickback. A band saw will even help you economize stock and create new design possibilities when you use it for resawing. You'll fall in love the first time you saw open a dazzling book-matched panel.

Band saws are sized by the distance from the throat of the frame to the blade. It sets the maximum width of cut you can make. A second and equally important capacity is how high you can raise the blade guard above the table. This determines the thickest stock you can cut. So, choosing the best band saw for your shop will require reaching a compromise between cost and cutting capacity.

Fourteen-inch band saws have dominated the home shop market for decades. They offer reasonable cutting width, around 6" of resaw height and decent power for the money. For ordinary curve cutting and ripping, they're still a great choice. You can even stretch the resawing capacity another 4 to 6 inches by adding a riser kit to your saw. I would avoid saws with less than 1hp motors if you plan to cut thick stock or do any resawing. An underpowered motor turns resawing into a slow and laborious job.

For wide resawing or roughing out large turning blanks, a larger 16" or 18" band saw may be the right long-term investment for you — even at twice the price of a 14" saw. These larger saws are really entry-level industrial tools. Their heavy-duty frames, wheels and blade tensioning systems are designed to accept wider 3/4" or 1" resawing blades. You'll benefit from a more powerful 2 to 5hp motor, a big cast-iron table and improved blade guides and guards. My 16" band saw has never let me down, and I'm quite certain it's capable of more performance than I demand from it.

Regarding features, a few are worth the extra cost. A quick-release blade tensioner will save you the effort of cranking your blade tension up and down each time you use the saw (it's a good habit to adopt). Look closely at the guides, too. Ball-bearing side and rear thrust guides will generally last longer than solid guides and help keep your saw tracking straight and true. A sturdy rip fence is important. And, an on-board work light really helps if your shop lighting isn't quite up to snuff. But, all things being equal,

Blade Tension, Tracking Improvements

Relieving tension on a band saw blade can extend its life. The process is simple with a quick-release, available on many new saws.

Top-flight blade guides will keep your cuts tracking straight and true. The best style: ball-bearing side guides and a rear thrust bearing.

A compound miter saw is your ticket to surgically clean crosscuts. Be sure to outfit it with a premium crosscutting blade for best results.

put your money into a saw with a large cast-iron table, 1½ to 3hp motor and good guides. These three components will ensure that your band saw will keep pace with your growing skills.

Miter Saws

Miter saws have migrated nicely from contractors' truck beds into our shops, and their dead-on cutting accuracy is going to keep them there. Sure, you can make perfectly serviceable crosscuts with your table saw and miter gauge, but I find myself checking and rechecking that accuracy constantly. Not a concern with a quality miter saw. Its oversized angle scale and preset detents are designed to be spot-on with every cut. Swing it to the angle you need, lock the knob and plunge the blade through. Once you've got your saw tuned up, you can trust it for making accurate miters and bevel cuts on your finest work. It's also my first stop for cutting rough stock to size.

Over the years, I've used both 10" and 12" compound miter saws and their sliding cousins. What does a woodworker really need? My advice is to buy a 12" dual-bevel compound miter saw or a 10" dual-bevel slider with nice bright scales and controls that are easy to manipulate. Make sure the saw can be connected to your shop vac; their little dust bags fill quickly. Laser guides are a common feature, but they often aren't that precise. A task light or pullout table extensions are actually better standard accessories.

Be sure to splurge for a premium crosscutting blade with 60 or more teeth. It may cost you upwards to $100, but the payback is immediate and lasting. I've had the same blade in my miter saw for years and it still produces clean cuts without resharpening.

Sanders

Sanding is inevitable before finishing, but I also use abrasives for fairing curves, chamfering pegs and taking a hint off of the ends of parts that don't quite match. I

Sander Trio Smoothes and Shapes in Short Order

Sanding doesn't have to be an all-day affair if you outfit your shop with the right machines. Your go-to tool for finishing prep will probably be a random-orbit sander with a hook-and-loop pad (left). The author recommends a benchtop spindle sander (middle) for cleaning up curves. A disc sander (right) is perfect for touching up miter angles, rounding over corners and evening up same-length parts when the need arises.

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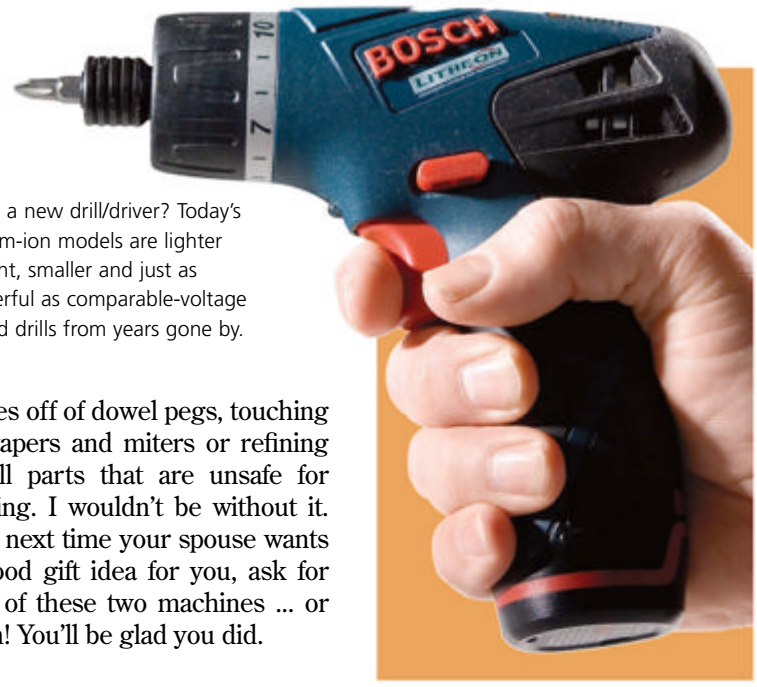


Need a new drill/driver? Today's lithium-ion models are lighter weight, smaller and just as powerful as comparable-voltage NiCad drills from years gone by.

turn to three different sanders: a 5" random-orbit, a 12" benchtop disk sander and a small oscillating spindle sander.

You're probably already using the first of these three. Random-orbits really do a great job of general smoothing, provided you don't skip grits or press down too hard. If you're in the market for a new R.O., buy one that connects to a vacuum.

When I purchased my disk and spindle sanders, neither cost more than $100. Low prices made them easier to justify, since neither seemed essential. As it turns out, I'm surprised how often I use them both. The oscillating motion of a spindle sander will take stock off much more quickly than a drum sander in a drill press, and it cleans away a regular scratch pattern. It's a wonder tool for working inside curves. My disk sander does a nice job of smoothing outside curves, knocking the edges off of dowel pegs, touching up tapers and miters or refining small parts that are unsafe for sawing. I wouldn't be without it. The next time your spouse wants a good gift idea for you, ask for one of these two machines ... or both! You'll be glad you did.

Fastening Tools

We all use cordless drills these days, but here's a hint when you retire your current gun: buy smaller. It wasn't too many years ago that battery voltages were going up faster than gas prices. But, I have yet to see the need for more than 18 volts for general woodworking. Drilling pilot or pocket holes and driving screws doesn't require even that much iron-man torque.

I've been using one of the newer 10.8-volt lithium ion drivers for a while now, and all in all, it's a powerful little tyke. The battery delivers a steady charge right up to the point of petering out. The tool holds its charge for months of non-use and weighs a fraction of my former driver. I rarely need more power, and I sure don't miss the extra bulk.

Nail guns are mighty handy in the shop, too. If your budget is pinched, buy an 18-gauge nailer that accepts the widest range of nail sizes possible (usually 5/8" to 2"). That way you can use it for tacking everything from drawer bottoms to face frames. Then someday, splurge on a 23-gauge pin nailer. You'd be surprised how much holding power can be had from a stick-pin-thickness nail. Once installed, the nail holes almost disappear, and they really don't need putty.

When shopping for nail guns, buy an 18-gauge brad nailer (left) that accepts nail sizes up to 2", if possible. A 23-gauge micro-pinner (below) is perfect for quick, almost invisible tacking or when installing tiny moldings.

"Slow but Sure" Shop

Don't let a small tool budget get you down. You can do a LOT of woodworking with a few good tools, so grow your collection slowly. Take the time to explore each tool's potential. If you stick with reputable manufacturers and buy with an eye to the future, your tool investments will do you proud for years to come — and without needing a second mortgage.

Chris Marshall is senior editor of Woodworker's Journal.

A Traditional European Workbench

HERE'S A WORKBENCH TO TOP ALL OTHERS. DESIGNED BY MASTER WOODWORKER FRANK KLAUSZ, YOU'LL USE IT FOR A LIFETIME, AND SO WILL YOUR CHILDREN'S CHILDREN.

Building a bench like this is an enjoyable process made up of many simple steps. A craftsman worthy of such a bench will be able to make it with ordinary hand and power tools. The benchtop is very heavy once it is glued up, so you'll want to have a helper on hand when you need to maneuver it around your shop.

Building the Base

The base of this bench consists of two leg trestles connected by two heavy rails that support a storage shelf. (For details, see the *Exploded View Drawings* on page 20.)

The first thing you must do is determine how high you want your bench to be and size the legs accordingly. For hand planing, the ideal height is generally considered to be the height of your palms from the floor when your arms are at your sides. This height allows you to make the best use of your body weight to push a hand plane down. For chiseling and other bench work, you can put blocks under the feet to raise the height a couple of inches. To determine the overall length of the legs, subtract 6½" from the overall bench height.

The legs are connected to the top rails with through-wedged mortise-and-tenon joints and to the foot rails with fox-wedged mortise-and-tenon joints. (See the *Drawings* on page 20 and the photo on page 21.) The shorter tenons may be cut on the table saw, using a tenoning jig for the vertical cuts; but the longer ones are best cut on the band saw, as demonstrated in the bottom photo at right.

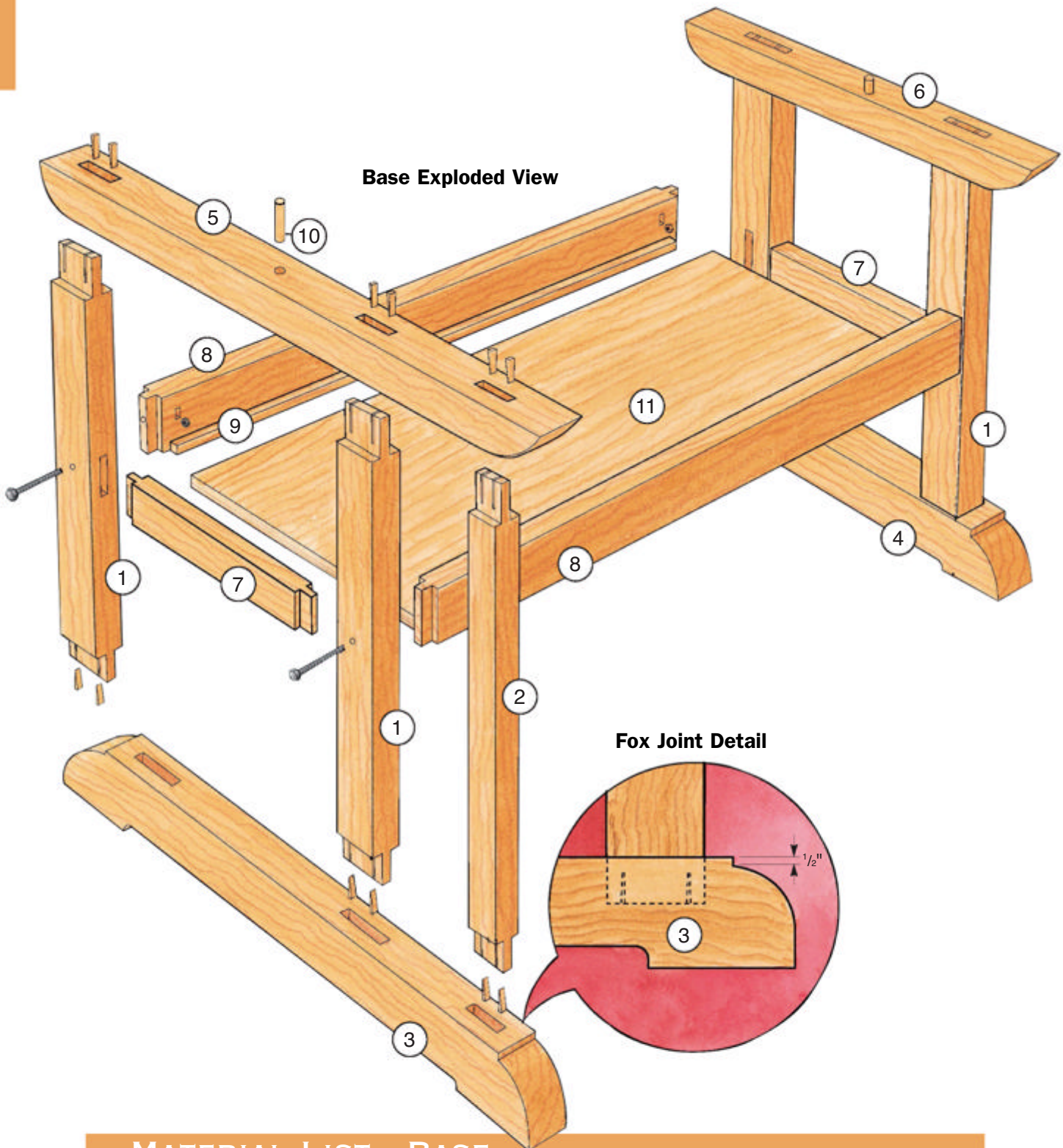
Use a cardboard template to lay out the curves on the feet and the top rails. Cut the curves on a band saw and smooth them out with a light pass on the disk sander, but don't cut out the recesses on the bottom of the feet until you have made all the mortises.

Cut the mortises for this bench with a mortising attachment on a drill press (see top photo, right), but you could drill them out with a brad-point or Forstner bit and clean them up with chisels if you don't have a mortiser.

Before you glue up the trestles, mortise the legs for the stub tenons of the stretcher rails that connect the trestles. Drill a 1/2" hole through the center of each mortise for the hex bolts that will join the rails to the legs. Dry-assemble the rails to the legs and drill the long holes into the ends of the rails. Rout or mortise a pocket about 3⅛" from the shoulder of each rail for a hex nut. Frank usually makes this pocket oversize, in order to get fingers or pliers in there to hold the nut in place. Finally, glue up the trestles (see the photo on page 21) and set them aside until the top of the bench is completed.

Mortise the feet before cutting out the recesses on the undersides. Here the author uses a mortising attachment on a drill press.

Cut the shorter bottom tenons of the legs and the stub tenons of the rails with a tenoning jig on the table saw. Use the band saw for shaping the through tenons, as shown here.



Material List - Base

		T x W x L
1	Legs* (4)	2⅜" x 3½" x Varies
2	Narrow Leg* (1)	2" x 2⅜" x Varies
3	Foot (1)	3¾" x 2¾" x 33"
4	Short Foot (1)	3¾" x 2¾" x 24"
5	Top Rail (1)	2⅜" x 2¾" x 33"
6	Short Top Rail (1)	2⅜" x 2¾" x 24"

		T x W x L
7	End Stretchers (2)	1½" x 2½" x 13½"
8	Long Rails (2)	1½" x 5" x 45"
9	Shelf Support Strips (2)	3/8" x 3/4" x 43"
10	Bullets (2)	3/4" Dia. x 3"
11	Shelf (1)	1/2" x 13" x 43"

**The legs are cut to length according to your height (see text).*

Selecting Lumber for the Workbench Top

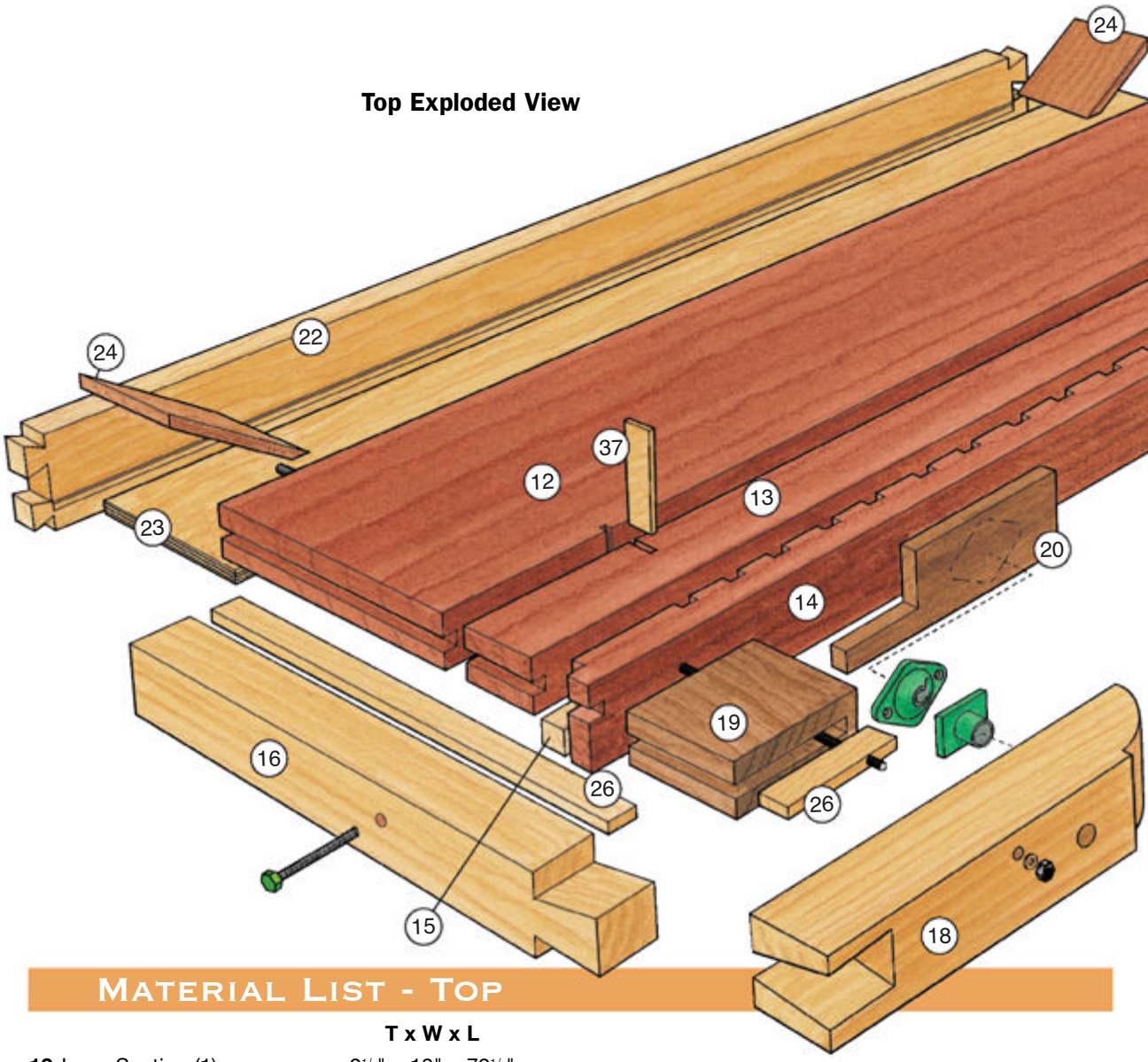
Next, make the main part of the benchtop. The top of the bench consists of a long section, usually made of two hefty 7"-wide boards, and a short front section that becomes the fixed jaw of the tail vise. (See the *Drawings* on pages 22 and 23.) The front piece of this shorter section is 4" high and contains a series of bench dog holes that align with opposing holes in the tail vise.

Begin by letting your lumber acclimate in your shop for a week or so before you start milling it. Then rip, joint and surface all the pieces. It does not matter if there are some rough mill marks or defects on the underside of the top, because these will not affect the utility of the bench. Frank recommends using the band saw to rip lumber that is more than 2" thick, because a band saw blade cuts through thick lumber much more efficiently than a table saw blade.

The legs are attached to the feet with fox-wedged tenons.

Assemble each trestle section with white glue and clamps. Here the author uses a mallet to drive the fox-wedged tenons home (into the bottom of the legs).

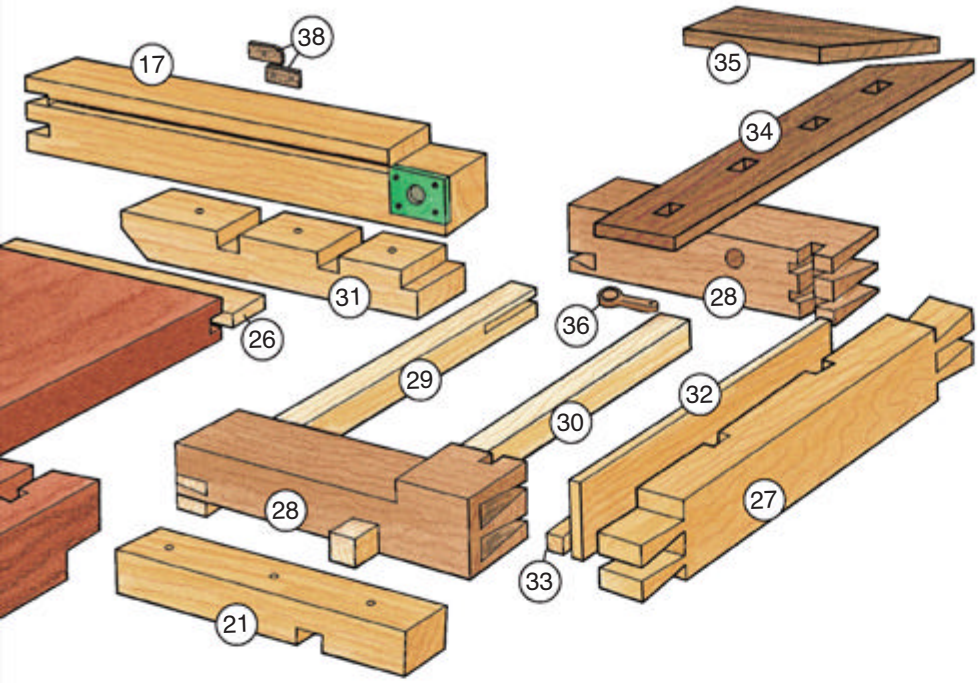
Top Exploded View



Material List - Top

	T x W x L
12 Long Section (1)	2½" x 13" x 72½"
13 Short Piece (1)	2½" x 3" x 58"
14 Front Lip (1)	2½" x 4" x 58"
15 Backer Strip (1)	1½" x 1½" x 58"
16 Long End Cap (1)	4" x 3¼" x 37½"
17 Short End Cap (1)	4" x 3¼" x 24¼"
18 Shoulder Vise Arm (1)	4" x 3¼" x 23"
19 Shoulder Block (1)	2½" x 8⅝" x 7½"
20 Shoulder Vise Jaw (1)	1" x 4" x 17½"
21 Inside Guide Block (1)	3" x 2¾" x 17¼"
22 Backboard (1)	1" x 4" x 76¼"
23 Tool Tray (1)	1/2" x 8⅜" x 7½"
24 Tool Tray Ramps (2)	1/2" x 7½" x 6½"
25 Spacer Blocks (2)	1½" x 3¼" x 22"
26 Plywood Spline Material	1/2" x 1½" x 60"

Tail Vise	**T x W x L**
27 Front Face (1)	2½" x 4¼" x 22½"
28 Jaws (Ends) (2)	3½" x 4¼" x 13½"
29 Back Rail (1)	1½" x 1⅜" x 23"
30 Center Rail (1)	1½" x 1⅜" x 17¼"
31 Outside Guide Block (1)	3¼" x 2¼" x 20"
32 Plywood Liner (1)	1/4" x 4¼" x 16"
33 Front Runner (1)	3/4" x 7/8" x 16"
34 Long Vise Cap (1)	7/8" x 5½" x 23"
35 Short Vise Cap (1)	7/8" x 4" x 13½"
Miscellaneous	**T x W x L**
36 Carved Oil Cup (1)	1/2" x 2" x 6"
37 Wooden Stop (1)	1/4" x 1¾" x 7"
38 Crosscut Stops (2)	1/4" x 1" x 3"



Making the Bench Dog Holes

To make the bench dog holes, cut slots in the front lip of the bench before gluing it to the other short section of the top (see the *Drawings* on pages 34 and 35). You want the dogs to tilt 2° toward the opposing bench dogs, so the slots must be at an 88° angle to the bench surface.

To cut the slots in both the front strip and the tail vise, Frank used a table saw sled that works like a box-joint jig, with a 3/4" dado blade and a tapered auxiliary fence that skews the workpiece 2° from perpendicular (see photo, below). Reverse the tapered fence for cutting the tail vise slots, because they need to slope 2° the other way.

Use a table saw sled with a 2° auxiliary fence to cut the bench dog slots in the tail vise face. Reverse the fence for the opposing slots in the front lip of the bench. A guide strip tacked to the sled ensures equal slot spacing.

After you make the first cut, tack a strip of wood the same thickness as your dado blade to the base of the sled at the appropriate hole spacing — in this case 5¾". After cutting the first slot, you can cut each successive slot by indexing the previous slot on the wood strip. Note: the last slot, at the end of the strip, has a different spacing. See the *Drawings* on pages 34 and 35 for more details about this slot.

Assembling the Top

Assembling the top involves several steps. Before you can glue the various parts together, you need to drill the hole for the threaded reinforcing rod that goes through the full width of the top at the shoulder vise.

To do this, clamp the two planks of the long section together and drill a 9/16" hole through the first into the second. Then clamp this section to the next section and repeat the process, drilling the hole progressively through all the parts, including the block and the arm of the shoulder vise. Use a spade bit with an extension attachment to do this.

Once you have drilled through all the pieces, rip grooves for the splines with a dado blade on your table saw. Glue up the 13"-wide section and the short front section separately. Use 1/2" x 1½" plywood splines and glue to join all the parts of the top, including the end caps and shoulder vise block.

Use a router with an edge guide to cut the spline grooves in the ends of the glued-up benchtop. These grooves will match the spline grooves you'll form later in the end caps.

Square off the short section and glue it to the long section, making sure that all the holes line up and that the splines don't interfere with them. Finally, trim the ends square and rout the grooves for the end cap splines (see photo, above).

Attaching the End Caps

Before you can attach the end caps, you'll need to first join the long end cap to the arm of the shoulder vise. This is a simple through-dovetail joint that you can cut on the band saw and clean up with chisels and rasps (see photos, below, and on page 26). Make an angled ramp, clamped to the band saw table, to tilt the shoulder vise arm when cutting the dovetail socket.

Dry-fit this dovetail, then disassemble the parts and rout or rip the spline grooves in both parts, stopping the grooves so they won't show when the parts are assembled. Cut the groove in the short end cap also. All the spline grooves should be centered on the thickness of the top.

Notch and drill the short end cap for the benchscrew nut at this time. You will need to drill a hole in the inside face with a Forstner bit for the cast-iron nut, then a smaller hole the rest of the way through for the screw itself. Then trace the benchscrew flange around the larger hole and rout the end cap to the depth of the flange. (A typical installation is shown in the photo on page 27.) Repeat this procedure for the shoulder vise benchscrew nut, and install both nuts with the appropriate sized screws before glue-up.

Next, drill the 1/2" holes through the end caps for the hex-head machine bolts that will reinforce their connection to the top (see *Drawings*). Start the holes from the inside of the end caps, centered on the spline groove. Then dry assemble the caps to the top and drill the long holes into the endgrain of the top. Remove the caps and continue the holes to their full depth. Drill or rout pockets in the underside of the top for the hex nuts, as you did with the rail joints in the base of the bench.

If necessary, trim the shoulder block for a perfect fit between the top and the end cap assembly. Rout spline grooves on three sides of the block and dry assemble it. Then, mark the finished length of both end caps at 8½" past the back edge of the top, and cut them to length on a miter or radial arm saw.

The final step before gluing on the end caps is to rout the dovetail sockets in the ends for the backboard. Frank used a simple router jig similar to the one for the tail-vise dovetails (see photos, page 28). The jig uses a 1/2"-diameter straight bit and a 5/8" template guide bushing.

Cut the large dovetail that joins the shoulder vise arm to the end cap with a band saw. Note the angle ramp clamped to the band saw table.

Clean and finish the joint with a paring chisel. Test-fit the joint before you try to glue it up and join it permanently. It should fit snugly but not too tight.

Glue-up isn't difficult, but it is somewhat complicated, so it's good to have a helper, if possible. Start by turning the top over, with a couple of beams underneath it to raise it off your assembly table. Do a dry run first, to make sure you have everything you need, including all the clamps, bolts and splines.

Frank used a brush to spread glue in the grooves and a small disposable paint roller to roll it onto the various surfaces quickly. White glue is a good choice for this application, as it allows more open time than yellow glue.

Get all the parts assembled before clamping them, because they must be tightened in all directions at once. At the shoulder vise end, clamp the big dovetail first with one long clamp lengthwise and another squeezing the joint itself. Then use another clamp to pull the vise arm and the shoulder block tight against the top and two more to clamp it to the end cap. Now, clamp both end caps at the same time with two 8-foot bar or pipe clamps, and tighten the bolts to pull both caps into tight contact with the ends of the top.

The final step of this main glue-up is to install and tighten the threaded rod with washers and hex nuts at each end (see photo, page 30). When the glue dries, plane or belt-sand all the joints flush.

Next, mill and install a solid strip of hardwood behind the row of dog holes. This encloses the holes and provides a larger clamping surface under the front lip of the bench, where you are always clamping workpieces. The backboard and tool tray are next on the list.

Frank likes to use a special piece of wood for the backboard, since it is so prominent on the customer side of the bench. Cut the backboard to the correct width and length to span the end caps. Then, clamp it temporarily to the ends so you can lay out the dovetails. Cut the dovetails with a band saw and clean them up with a chisel.

Now, plow a 1/4"-deep groove in the backboard for the tool tray, at a height equal to the thickness of your benchtop. Rip your plywood for the tray to a width that will underhang the benchtop by about an inch when fully seated in the groove in the backboard.

Glue the tray into the backboard, then install the assembled parts to the bench, gluing and screwing the tool tray to the underside of the bench (see bottom photo, page 32).

To complete the top, install spacer blocks with screws and glue to the underside, where the top rails of the base will meet the top as shown in the top photo on page 32.

Making the Tail Vise

Many woodworkers are nervous about making a tail vise, because it appears so complicated. In fact, it is only parts and pieces, like anything else you make.

Begin by building the tail vise frame, which consists of two jaws dovetailed to a face piece, and a back runner connecting the front and rear jaws (see the *Exploded View* on page 22). Frank's design uses through dovetails at the rear jaw but half-blind dovetails at the front jaw, to provide an unbroken face-grain surface where it meets the other jaw. Here again, he uses a simple router jig to hog out the dovetail sockets, then cleans

them up with a chisel. The tails themselves are band-sawn carefully and then pared to final fit with chisels. While the front vise jaw is still free, joint about 1/8" off the rearward part so you'll be able to resurface the clamping surface of the jaw a couple of times in the future, as necessary.

The dovetail joints that join the back rail to the jaws are also easily cut with a band saw. The top of this runner should be even with the bottom of the end cap when the vise is assembled to the bench. To make sure this happens, drill the clearance hole for the benchscrew in the rear jaw so that it is the same height up from the runner as the benchscrew nut is from the bottom of the end cap. Drill this hole slightly oversize so you have some room for adjustment when assembling the tail vise to the bench. (Refer to the *Drawings* for details.)

To complete the tail vise subassembly, glue a thin piece of plywood to the inside of the face piece to close off the bench dog slots and install the hardwood runner to support the front of the vise.

Installing the Tail Vise

In order to attach the tail vise, you'll need to make two guide blocks and one more runner. The outside guide block bolts

Bar clamps and hex-head bolts with captive nuts connect the end caps to the benchtop. Note the installation of the benchscrew nut in the short end cap.

Through and half-blind dovetails join the face of the tail vise to the front and rear jaws. A simple router jig guides a template bushing and straight bit to remove most of the material, and a sharp chisel finishes the job.

to the underside of the end cap, and the inside block is bolted and glued to the underside of the top, where it forms the lower part of the vise jaw. (Again, look at the *Elevation Drawings* for these construction details.) The runner is bolted into a notch in the inner block and slides in the notch in the main jaw of the vise as shown in the inset photo on page 30.

For smooth operation of the tail vise, it is critical to make all the parts accurately and to be sure the runners are parallel to each other and to the benchtop. Before you install the benchscrew, move the tail vise through the full range of its motion by hand to check for binding and interference. Any misalignment or eventual sagging can be fixed by shimming the runners and rails as needed.

Once you have everything running smoothly, with as little slop as possible, you can install the benchscrew. Run it all the way in, center it in the clearance hole, and screw the flange to the rear jaw of the tail vise.

Making the Vise Caps

Next, make the vise caps. The two parts of the cap should be thicker and wider than necessary; you will trim them after installation. Miter the ends where they meet, then set the larger part of the cap onto the completed tail vise, with the inside of the miter aligned with the inside corner of the frame. Mark the bench dog hole locations from the underside, then drill and chop the corresponding holes in the top cap.

Finally, glue the two parts of the cap together at the miter, and assemble them to the frame with glue and clamps. Then plane them flush with the benchtop and tail vise surfaces.

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After clamping all the parts together and bolting the end caps, the final step in the glue-up is to install and tighten the threaded rod that reinforces the shoulder vise.

To assemble the tail vise, bolt the center guide rail to the fixed tail vise jaw and then bolt the outside guide block to the end cap. Finish up by installing the bench screw.

Finishing Touches

At this point, the bench is nearly finished. There are just a few more important details left to do.

First, mount the top on the base. Frank uses rock maple "bullets" to register the top to the base. Turn the bullets to 3/4" diameter as shown in the *Drawings*. Glue one into each of the two bearing strips on the underside of the benchtop. Drill mating holes in the top rails of the base so the bullets will register the top in the exact location each time you assemble the bench. After you install the bullets, drill through the top rails of the base for the 1/2" lag screws that secure the top.

Next, modify the benchscrew for the shoulder vise. The shoulder vise on this bench is designed to open to about 5½". When the vise is closed, you want the handle to come to rest about 1/2" from the arm of the shoulder vise. The stock benchscrew that Frank used for the shoulder vise was 2" too long, so he had to shorten it.

Details Make the Difference

Carved Oil Cup

Leather Vise Liners

Ebony Crosscut Stop

Small but important details elevate Frank's bench to the highest level of craftsmanship. The carved oil cup mounted to the underside of the tail vise, for instance, is a handy place to keep a little vegetable oil to lubricate anything that needs it, such as saws and plane soles.

Leather vise liners are another delightful finishing touch featured on Frank's bench. The leather protects the jaws and the work. When it wears out or gets damaged, you can soak it off and replace it.

And, of course, the fold-down crosscut stop at the end of Frank's bench is another detail that truly enhances the performance of his classic design.

First, he punched out the roll pin that holds the screw into the handle casting. Then he used a reciprocating saw to cut off 2" from the end of the screw and ground the end of the screw to fit back in the handle casting. He made a simple V-block jig to hold the screw at the proper height for grinding. Frank screwed the jig to his grinding bench with a single screw at the rear corner in order to pivot the jig toward the grinding wheel. When he reached the right diameter, he reinstalled the screw in the handle. This procedure worked well.

Building the Wooden Vise Jaw

Once you have bolted the top to the base and cut the benchscrew to length, you're ready to make the wooden vise jaw for your shoulder vise. Frank used a 1"-thick piece of rosewood for his, but any seasoned hardwood is okay for this detail. Make it a little wider than necessary so you can plane it flush with your bench after you install it.

The wooden vise jaw has an extension on the left end that fits between the shoulder block and the top rail of the base. It is connected to the benchscrew by a cast-iron foot that allows the jaw to pivot left or right to accommodate tapered or odd-shaped workpieces.

To locate the pivoting foot accurately, hold the wooden jaw in place and tighten the benchscrew against it (with the swiveling foot attached), making sure the open side of the foot faces to the right. Trace the outline of the foot onto your vise pad, then remove the pad and rout a 3/8"-deep recess in it to receive the foot. This allows the jaw to open a bit wider, and it looks better, too.

Constructing a Wooden Stop

The wooden stop is another useful feature of this bench. It is simply a strip of tough hardwood — Frank used holly — that fits tightly into a rectangular mortise through the top (see the *Drawings*). A tap of a hammer or mallet from below raises it to working height for planing thin pieces of wood.

To make the mortise, drill a series of 1/4" holes with a brad-point bit, and then remove the waste between them with a paring chisel. The mortise should slope about 2° from vertical, toward the right end of the bench. It's a good idea to make the mortise first, then make the stop to fit the mortise.

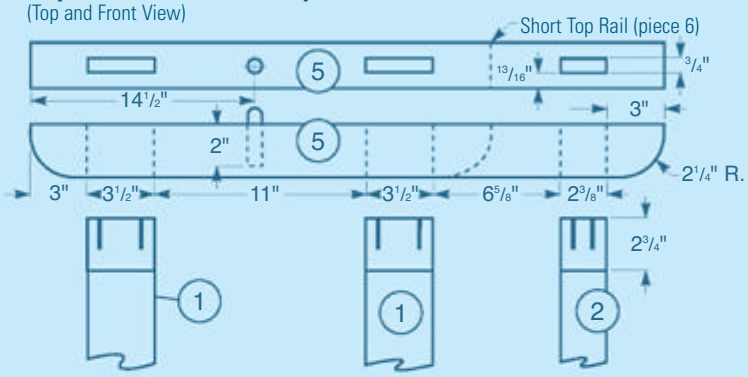
Frank likes to finish his benches with Waterlox® wiping varnish. A few coats at the beginning and a little more from time to time keep the bench looking beautiful. Make sure to seal up the entire bench with the finish, including under the benchtop. This will equalize moisture that moves into and out of the wood as the seasons change.

If you build Frank's bench, you will have a trusty shop friend forever. You may even ask yourself how you worked without this bench up until now. Many years from now, your children will thank you, too.

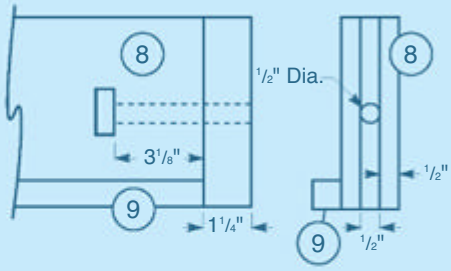
Attach spacer blocks to the underside of the benchtop where it meets the trestles. Then glue one maple "bullet" into each spacer block and drill mating holes in the tops of the trestles to locate the top perfectly each time you assemble the bench.

After gluing the backboard to the ends of the end caps, glue the plywood tool tray into the groove in the backboard and screw and glue it to the underside of the benchtop.

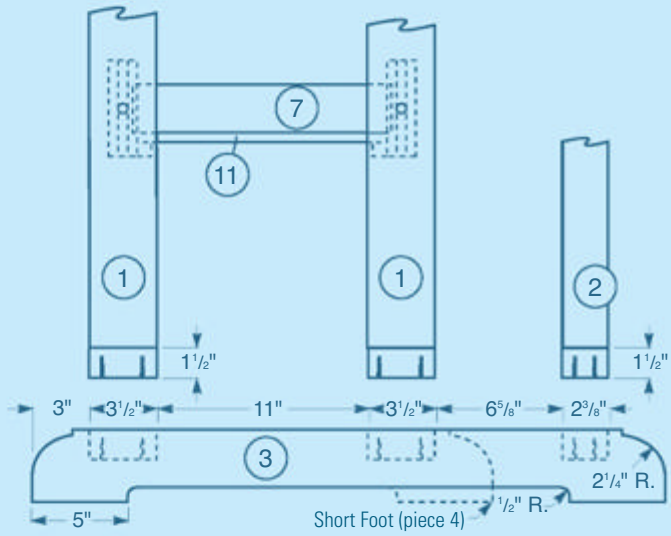
Top Rail and Short Top Rail
(Top and Front View)



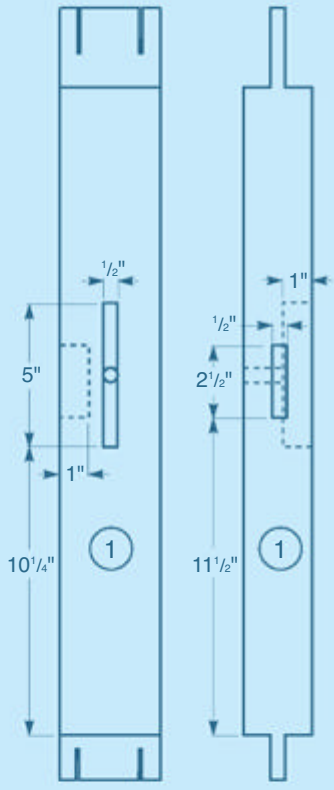
Long Rail and Shelf Support
(Inside and End Views)



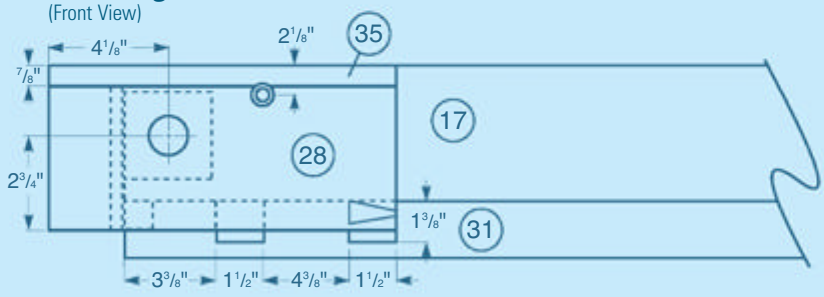
Bench End Subassembly
(Front View)



Leg
(Stretcher and Rail Locations)



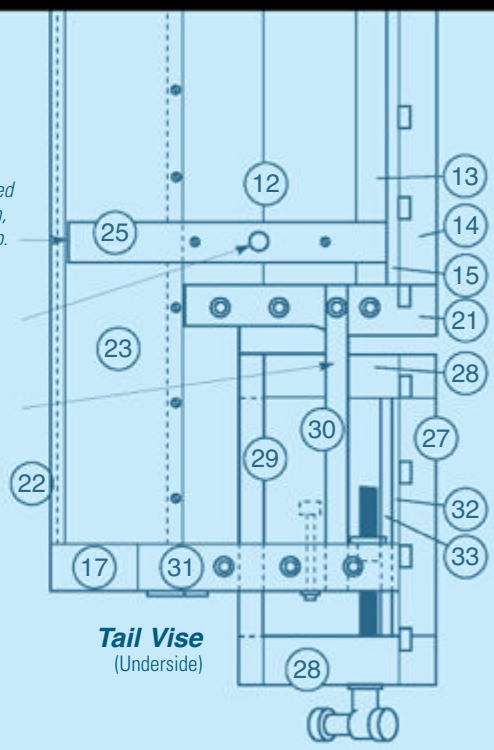
Shoulder Vise Screw Mounting Detail
(Front View)



The two spacer blocks are notched to accommodate the tray bottom, providing a level base for the top.

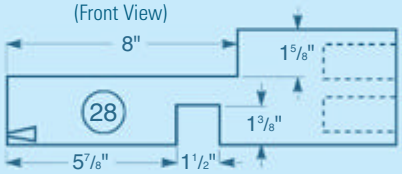
Drill a 3/4" hole for a "bullet" dowel so the top can be placed accurately on the base.

The center rail is screwed into the inside guide block and short end cap. It supports and guides the vise movement.

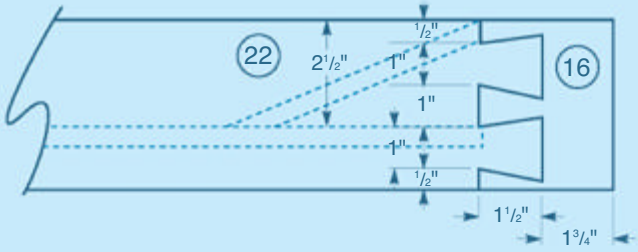


Tail Vise
(Underside)

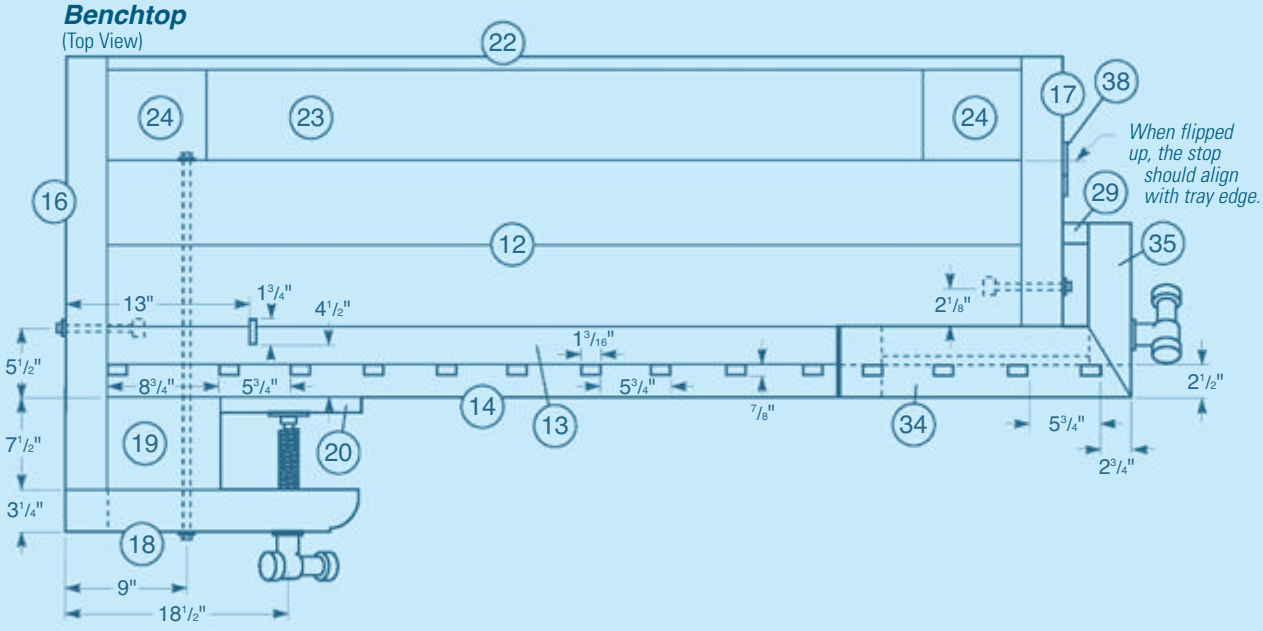
Inner Jaw Detail
(Front View)



Backboard/Long End Cap Dovetail Detail
(Rear View)



Benchtop
(Top View)



Keeping Your Shop Cool

WHEN THE SPACE YOU'RE WORKING IN FEELS MORE LIKE AN OVEN THAN A SHOP, THERE ARE MANY WAYS TO MAKE IT COOLER AND MORE COMFORTABLE.

Trees, vines and other plantings around Del Cover's San Diego woodshop add character while blocking the sun and keeping his shop cooler.

Although we're capable of traveling to the far, frozen reaches of outer space as well as trekking across scorching deserts, we humans actually have a relatively narrow range of temperatures and humidity levels at which we're truly comfortable. And it's important to feel comfortable when you're making sawdust: you need to keep your concentration when using power tools.

Keeping the mercury and moisture level down in the workshop not only makes woodworking a more pleasant pursuit, but it also helps prevent problems like tool rusting and lumber warping and checking. Excessive heat can also ruin adhesives and finishing supplies, as well as cause problems when gluing or applying finishes.

Fortunately, there are numerous cooling options available. In this article, we'll explore some strategies for making your shop a cool place to work when temperatures climb. There are basically three ways to make your shop a cooler place: 1. Keep the heat from coming in. 2. Get the hot air out and replace it with cooler air. 3. Condition the air inside the shop to make it cooler and

drier. Even better, there's a lot more you can do to put high temperatures in check beyond simply switching on a power-hungry air conditioner.

Shade Trees, Vines, Etc.

One way to help keep your shop space cool is to prevent heat from getting into it in the first place. Having good insulation (which we'll talk about in a moment) is the most obvious way of accomplishing this, but there are several other things you can do to reduce your shop's heat gain:

One option to keep the heat out is to utilize shade trees, bushes and vines. Any plants located near your shop that provide a good deal of shade can keep a shop noticeably cooler and are a very "green" alternative to using electric cooling devices. If your shop lacks nearby trees or large bushes, consider adding a trellis to the south-facing side of the building and training a quick-growing vine to climb onto it. It's best to choose a type of vine that provides good shade coverage, yet loses its leaves in the winter (the same goes for bushes or trees planted near the shop). This will allow the sun to shine on your shop in the winter, to help keep it warmer.

Awnings and Blinds

Installing awnings over doorways and window openings can reduce solar heat gain in the summer by up to 65% on south-facing windows and 77% on west-facing windows. Awnings made from acrylic and polyvinyl laminates are water-repellent and resist fading and last much longer than traditional canvas awnings. Although they are more expensive, retractable awnings are a good choice, as you can adjust them to provide just the amount of shade you desire — large ones can even shade the entire side of a shop and/or create a shady spot for working outside. Leaving them retracted during winter helps prolong fabric life as well as allowing the warming sun in.

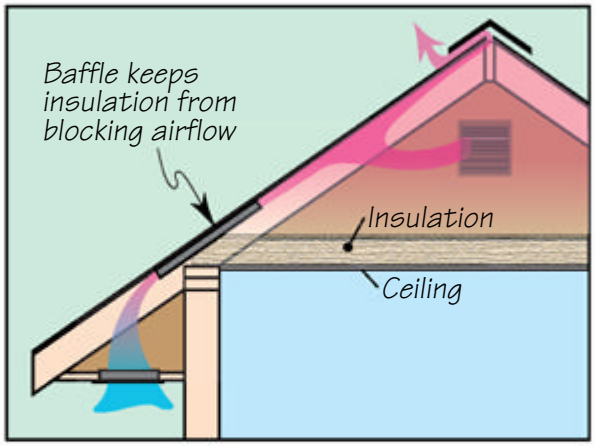
A retractable awning mounted on the front of Dale Stauffer's shop creates shade that helps keep his shop cooler in hot weather.

Interior window blinds are not as effective as awnings, but can help reduce heat gain for windows that are exposed to direct sun. On the downside, they collect dust: metal or plastic Venetian-style blinds are hard to clean, and fabric drapes and paper roll-up shades may present a fire hazard.

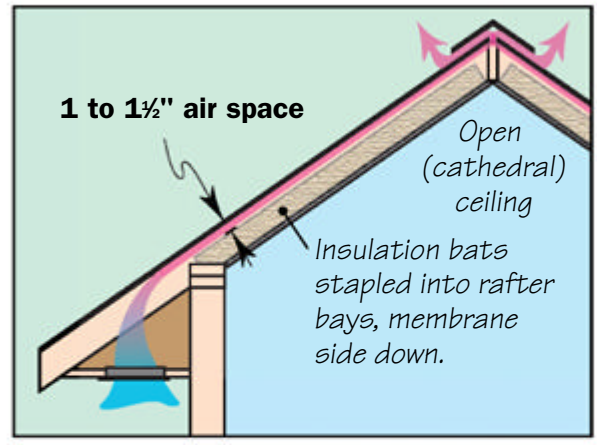
A better alternative is to treat windows that receive a lot of sun with a high-reflectivity film. Silver, mirror-like films are more effective than the more transparent colored films, and you can apply them yourself. On the downside, they do reduce interior light and make it harder to see outside. Plus, you must take more care when cleaning them, and they can create harsh glare to areas outside the shop.

Pale Paint and Roofs

If you live in a really hot climate (think Arizona desert), painting your shop white or a



Inexpensive air baffles stapled to the underside of the roof prevent attic insulation from blocking cool air flowing in from vents at the bottom of the eaves.



The small air space left above an open ceiling's insulation allows hot air to escape through the roof ridge vents as cool air flows in from eave vents below.

light tone and having a reflective or light-colored roof can help reduce heat penetration by up to a few degrees. That's not much, but every little bit helps, especially if you ultimately run an energy-hungry air conditioner for long periods of time just to bring shop temperatures down to comfortable levels during the summer.

Insulation

The single most effective way to keep heat out of the shop is to insulate it well. Insulation makes it harder for heat to penetrate walls and ceilings, as well as (of course) keeping heat in during cold days.

There are two basic ways of insulating a building: adding thermal mass and creating an insulative boundary. Thermal mass is usually found in the form of thick, dense walls that don't conduct heat well: think of how cool it feels inside a stone castle or down in a basement or cellar, where the earth itself provides thermal mass. It's not practical to replace walls in an existing shop, but if you're planning on building a new shop in a really hot climate, consider using concrete block, adobe and other masonry construction materials. It'll cost more upfront, but you'll save on energy bills in the long run and have a much more comfortable place to do woodworking.

You can also add good insulation to an existing shop. There are many insulation materials suitable for residential construction, including fiberglass rolls and bats, rigid foam and fibrous boards, spray foams, etc., some of which are easily installed. Additionally, there are blow-in insulating materials, such as cellulose, mineral wool and fiberglass, which can add insulation to existing sheetrocked or paneled walls and spaces too difficult to insulate with other materials. You can rent a machine and blow in the insulation yourself, or hire a specialized contractor to do the job for you (see this link for more information on insulation materials: *http://energy.gov/energysaver/articles/types-insulation*.

Showing you exactly how to insulate your shop is well beyond the scope of this article; there is plenty of reference information in magazines and books or online. It's also good to consult with a professional insulation contractor, even if you plan to do most of the work yourself.

However, I can warn you of a couple of common mistakes when insulating a shop: 1. When adding thick insulation between the joists above a sheetrocked ceiling, take care not to block the attic's eave vents (see the *Drawing*, above). The vents allow cooler air to flow into the attic to replace hot air escaping from the gable or roof ridge vents. To prevent this problem, it's easy to install air baffles, as shown in the *Drawing*. 2. If your shop has a cathedral style open ceiling with exposed rafters, don't just stuff insulation between the rafters! It's best to leave about 1 to 1½" of clear space between the top of the insulation bat and the underside of the roof sheathing. There must also be an eave vent at the bottom and a ridge vent at the top of each rafter bay (see the *Drawing*). This allows hot, moist air that would otherwise be trapped above the insulation to escape. You can buy special cathedral ceiling bats, which are thinner than usual fiberglass bats or rolls with the same R value (the higher the R number, the greater the insulative value): 8¼" thick (R30 rated) for 2x10 rafters; 10" thick (R38) for 2x12 rafters.

Bats of insulation have been set between the rafters on this shop's open ceiling, leaving an open space that allows air circulation.

Doors and Windows

You can reduce heat infiltration by fitting your shop with better insulated doors, windows and skylights. Exterior doors made of steel and fiberglass both have foam cores that reduce heat transfers somewhat better than wooden doors (steel doors and frames are also less susceptible to break-in). For maximum benefit, look for doors that are Energy Star certified. Larger barn- and garage-type doors also come with foam cores that supply varying degrees of insulation, as specified by their R value.

Another way to reduce heat is by fitting windows that conduct heat less readily. Many new windows (and skylights) are labeled with energy saving information, including a "U-factor," which indicates the window's thermal conductivity. A lower U-factor number indicates a better-insulating window (the inverse of R value). Double-pane windows insulate about twice as well as single-pane windows, and the window frame material can also affect its insulative value, with wood and vinyl frames having lower U-factors than aluminum frames.

Getting the Heat Out

Once warmer air has collected inside your shop, your main options are to cool it (we'll talk about that shortly) or exchange it for cooler air outside the shop. Simple ventilation is the easiest way to get rid of warm inside air and, if you live in a moderate climate, may be the only means of shop cooling you'll need.

If your shop's in a location that gets an afternoon breeze, you should be able to cool it down by opening windows or doors on the side the breeze is coming from, as well as opening a skylight, window or vent on the opposite wall to let the hot air out. If the breeze is weak (or nonexistent), you can ventilate using one or more box fans, either to blow air in from the cooler side of the building or exhaust hotter air by blowing it out on the hotter side. Even better: Use fans in both locations to create a "push-pull" effect that exhausts hot air and draws in cool air. If your shop has a ceiling with an attic space above it, make sure that hot air is allowed to freely escape from the attic, either through gable or roof ridge vents. You can also mount a ventilator turbine atop the roof and use the outside breeze to exhaust hot air from either an attic or a shop with an open ceiling.

If the air outside your shop is as hot as or hotter than the air inside, there's no sense in drawing the outside air in. In lieu of running an air conditioner, there's one good old-fashioned option: Use a fan (or fans) to circulate the air around the shop. A portable fan or a ceiling fan will bring slightly cooler air up from the floor of the shop and circulate it around, generating a comforting breeze. By positioning the fan(s) to blow air past you, you'll take advantage of the cooling effect that evaporating perspiration causes.

If you do plan on using ventilation to cool your shop, consider reducing the amount of heat generated inside the shop as well. Replace hot incandescent and quartz lights with cooler fluorescents and move dust collectors and compressors to a closet or attached shed. Doing so not only removes heat-producing devices from the shop, but also reduces shop noise and frees up valuable floor space as well. (If you move

Adding rigid insulation to the inside surface of doors helps keep the shop cool.

A roof-mounted ventilator turbine allows hot air to escape from the shop's attic space.

the dust collector, make sure the system returns filtered air back to the shop, instead of blowing it outdoors, lest your cooled — or heated — air is lost.)

Cooling the Shop

If you live and work in a place where summer temperatures regularly climb into the 90s or 100s — and sometimes stay there for days on end — your shop probably needs some form of air conditioning. There are several different types of air cooling and/or conditioning devices to choose from, including standard air conditioners, mini split systems, evaporative coolers and dehumidifiers. The best choice for your shop depends on your budget (for purchasing, installing and operating the unit), how much cooling you need and the kind of climate you live in.

A powerful fan mounted in a doorway provides an effective way to ventilate the shop on a hot day.

Standard air conditioners employ a compressor, condenser and evaporator (same as your refrigerator) to cool the fan-blown air passing though them. Not only is the temperature of the air reduced, but its moisture content is lowered as well. While larger, industrial air conditioners have the capacity to cool large shop spaces, they're very expensive to install and run. For smaller shops (up to 1,500 sq. ft.) located in moderate climates, a window-mounted unit is affordable, easy to install, and can lower temperatures enough to make the air more comfortable during the hottest days of summer. Air conditioners are sized by their BTU capacity, and window-mounted models typically range from 8,000 to 25,000 BTUs. A 12,000 BTU unit is about right for a two-car garage-sized shop.

One issue with running a regular household air conditioner in a woodshop is clogging due to wood dust. A way to deal with this is to simply duct tape an inexpensive fiberglass furnace filter to the front of the unit, to act as a pre-filter. Cleaning the pre-filter, as well as the air conditioner's built-in filter, often (every day if you're doing lots of sanding) by blowing it clean with compressed air should keep the air conditioner in good working order.

Mini Splits

Mini splits are electric heat pump systems that not only cool your shop in the summer, but can heat it in the winter as well. The system consists of a 220-volt-powered outdoor-mounted compressor/condenser unit that's connected via copper tubing to one or more indoor evaporator units — no expensive ductwork is needed. The outdoor unit pumps cooled refrigerant through the tubing to the indoor unit(s), and a fan blows the cooled (or heated) air around the shop.

Although more expensive and trickier to install than a regular air conditioner (you do save the cost of having to install a separate heating system), a mini split system is very safe for use in a woodshop and is relatively inexpensive to run thanks to inverter technology that allows the unit's compressor to operate at variable speeds that deliver only as much cooling/heating as needed.

Relocating the compressor and dust collector to an outside shed removes these heat sources from the shop.

A portable evaporative cooler directs fan-blown air through water to cool it down rapidly.

Evaporative coolers are an economical alternative to standard air conditioners. They use a powerful fan to draw warm air past water-moistened pads where it is cooled by — you guessed it — the process of evaporation. The air blowing out is not only cooler, in terms of temperature, but creates a breeze which makes the ambient temperature of a shop feel several degrees lower than it actually is.

Evaporative coolers come in both portable and stationary (window- or roof-mounted) models, and are sized by their CFM (cubic feet per minute) of airflow. A good rule of thumb for sizing a unit is to take the cubic (not square) footage of your shop and divide it by two. For example, a 2,400 square foot shop would need a unit rated for 1,200 CFM.

Commonly called "swamp coolers," evaporative coolers work best in hot, dry climates where low humidity is the norm, as in the Southwest. For example, at 10% humidity, an evaporative cooler can drop shop temperatures by as much as 20 to 30 degrees; while at 50% humidity, the cooler can only lower air temperature by about 10 degrees. Clearly, an evaporative cooler is a very poor choice in regions with high summer humidity. Swamp coolers also add moisture to the air, so it's a good idea to monitor your shop's relative humidity with a hygrometer and make sure it doesn't climb much above 45%.

Dehumidifiers

Speaking of high humidity, having too much moisture in the air inside your shop is definitely a bad thing: rusty tools, finishing problems, lumber with a too-high moisture content, etc. Reducing airborne moisture not only helps alleviate these problems, it can make you feel cooler, too.

A person's perspiration helps return their skin temperature to a more comfortable level when it's hot, and dry air favors evaporative cooling, while damp air does not. A portable electric dehumidifier provides an economical way of removing moisture from the air, and hence can make your shop feel cooler — even if the ambient temperature stays the same. This is most effective in regions that experience high humidity during hot weather.

Dehumidifiers are sized by the number of pints of water they remove from the air in a 24 hour period. You can find an online chart here: *www.energystar.gov/index.cfm?c=dehumid.pr_basics_dehumidifiers* that shows you the right size unit for your shop, depending on its square footage and how damp it gets. For example, a two-car garage-sized shop that's "moderately damp" (musty odors detectable during humid weather) requires a dehumidifier rated at 10 pints.

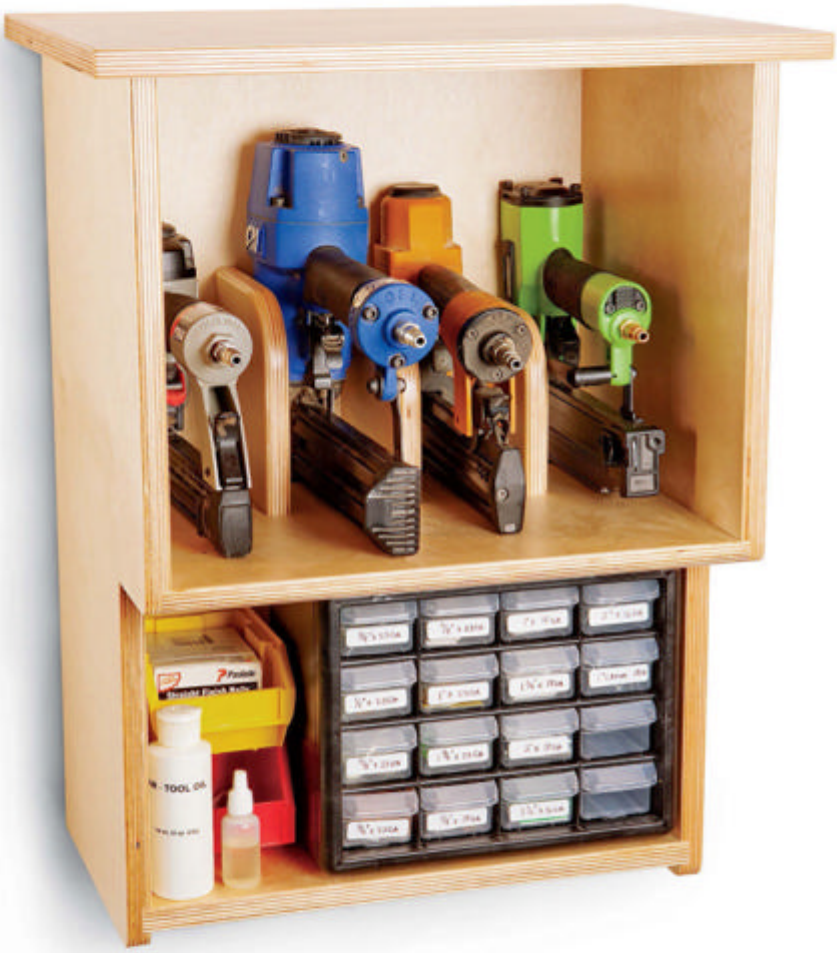
Incorporating one or more of the insulating, cooling or dehumidifying strategies we've explored in this article will surely help keep your shop cooler and more comfortable even during the hottest "dog days" of summer.

Sandor Nagyszalanczy is a contributing editor to Woodworker's Journal.

A dehumidifier helps keep a shop's air drier, thus making it feel cooler as well.

Nail Gun Cabinet

ORGANIZE YOUR AIR NAILERS AND NAIL SUPPLY, TOO.



Clamp the top shelf between the sides, and secure it with glue and 3/4" brads driven into the dadoes from below at a steep angle.

Use your nail guns as spacers to position the dividers. Clamp each before securing it to the back panel and shelf with countersunk screws.

Nail guns have a way of multiplying in my shop. It began with an 18-gauge brad nailer, followed by a finish nailer, pin nailer and crown stapler. If your collection has also grown, you know that more nailers means more nail sizes. Those little blister packs of fasteners ended up scattered, and I found myself buying duplicates instead of just getting better organized. Well, no more. This plywood cabinet will keep everything tidy. My idea started with the black plastic 16-drawer case you see above. I found it at *Grainger.com* (item C10116) for $23. The drawers fit full nail clips like they were made for them. Now I know where every size is and when I need to buy more — or when I don't.

Making the Sides

Begin the side panels by cutting two 3/4" plywood blanks to size, then lay out and remove the lower "stepped" portion from both using your band saw or jigsaw. See the *Drawing*, next page. Next, cut the top shelf to size, and make an overly long blank for the back panel that measures 16¼" x 19⅞". Tilt the blade on your table saw to 45 degrees and slice off a 5" piece from one end. This beveled offcut forms the French cleat for mounting the cabinet to the wall.

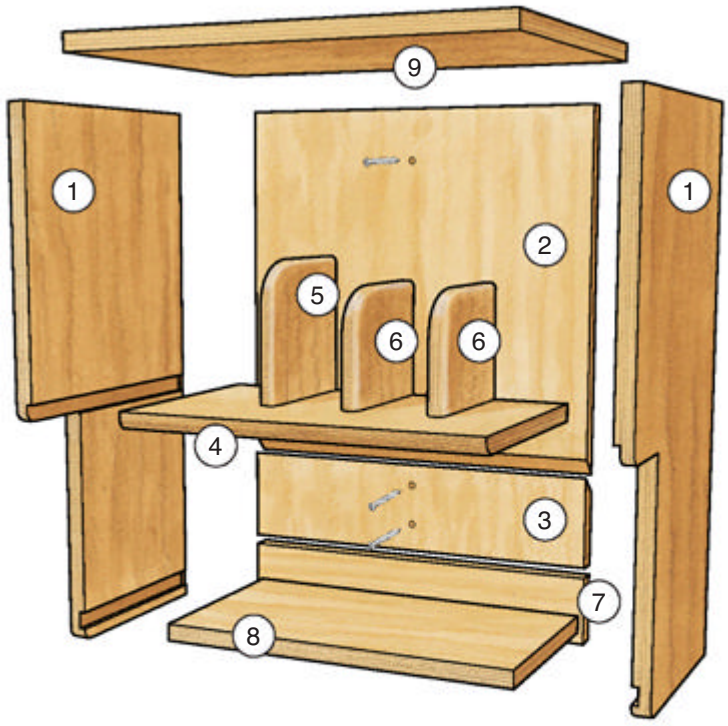
Switch out your standard blade for a dado set, and adjust it carefully so its cutting width matches the thickness of your plywood stock. Raise it a quarter inch above the table. Use your miter gauge outfitted with a long fence to support the side panels as you cut the top and bottom shelf dadoes. Notice that the top shelf dado intersects the stepped edge of the side panels. And remember, the sides are mirror images of each other — not carbon copies. This matters when orienting the panels correctly for dadoing.

With these dadoes done, crank

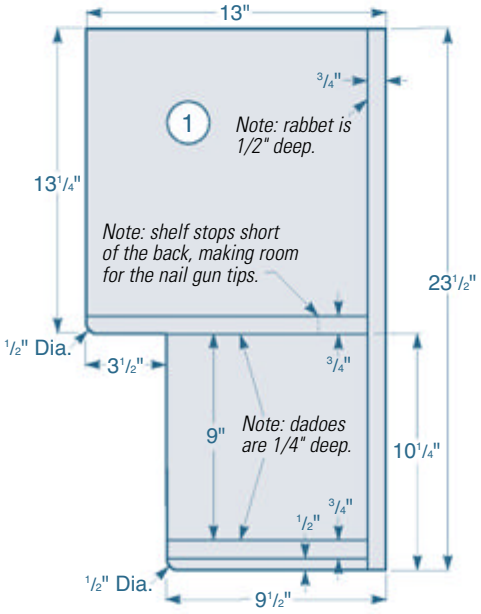
Material List

		T x W x L
1	Sides (2)	3/4" x 13" x 23½"
2	Back (1)	3/4" x 16¼" x 14¾"
3	French Cleat* (1)	3/4" x 16¼" x 5"
4	Top Shelf (1)	3/4" x 10" x 15¾"
5	Tall Divider (1)	3/4" x 6" x 6"
6	Short Dividers (2)	3/4" x 6" x 5"
7	Bottom Cleat (1)	3/4" x 3" x 16¼"
8	Bottom Shelf (1)	3/4" x 8¾" x 15¾"
9	Top (1)	3/4" x 14" x 18¾"

** Pieces 2 and 3 are cut from the same blank.*



Side (Inside View)



the blade up to 1/2". Clamp a sacrificial facing to your rip fence, then position the fence next to the blade to mill 3/4"-wide rabbets along the back inside edges of the side panels. These will house the back panel.

Before you can assemble your parts, chuck a 1/2"-diameter roundover bit in your router and ease the front bottom edge of the top shelf. Now clamp the shelf into its dadoes in the sides and use the shaped edge as a guide for filing the square corners of the sides to match the shelf. (You'll also notice that the top shelf stops short of the back panel rabbet by 2½" — it's no mistake. That gap makes room for the protruding nailing tips of your guns so they'll rest flat on their magazines on the shelf.) Round over the bottom front corners of the side panels, too.

This is the right time to sand all of the project parts up to 180 grit. Mask off the dadoes and rabbets in the sides before applying finish.

Assembling the Carcass

Avoid making the same mistake I've made before when assembling parts with French cleats: Your back panel's beveled edge should face into the cabinet, not toward the wall. Fasten it into the side panel rabbets with glue and screws to bring these parts together. Then slip the top shelf into its dadoes and attach it with glue and brads.

I made three dividers in sizes to support my guns and make them easy to grab, but the proportions should work for most models. Shape their top corners with a 2" radius and round over the sharp leading edges. Finish the dividers before screwing them to the top shelf and back panel, spaced as needed to fit your guns.

The cabinet's French cleat system makes it easy to position and hang from a single wall stud.

Wrapping Up

Turn more plywood into the bottom cleat, bottom shelf and cabinet top panels. Finish and install them, locating the bottom cleat flush with the bottoms of the side panels — it creates enough clear space for the French cleat to fit through the cabinet back and up into place. Then find a wall stud to mount the French cleat — bevel edge facing the wall. Rest your cabinet on it. Drive another screw through the back panel into the stud to lock the project in place. Now load it up for better nailer storage and convenience!

Chris Marshall is senior editor of Woodworker's Journal.

Avoid Tearout by Reading the Grain

LEARNING HOW CERTAIN GRAIN PATTERNS REACT TO BEING MILLED IS KEY TO CLEANER JOINTING AND PLANING.

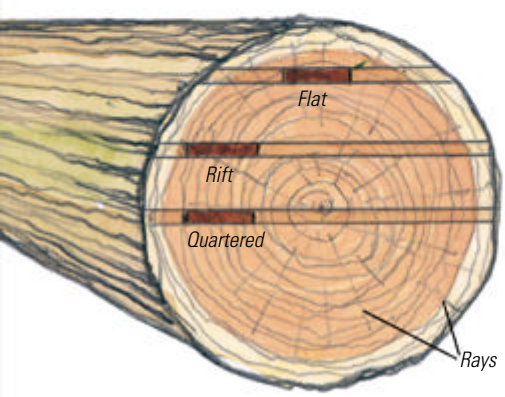
In my opinion, the number one challenge in woodworking is avoiding tearout. Fortunately, it is fairly predictable if you know how to "read the grain." That refers to observing the grain pattern in a board and interpreting how its grain or tissue orientation will react when you are cutting it, especially in regard to planers and jointers (including hand planes). After teaching woodworking for many years, I find many woodworkers don't understand the concept. While the practice of reading the grain is exceedingly helpful, even the most experienced person can be surprised by reversing grain.

When viewed from the end, a log's grain looks like a spider web (see the illustration at left). That grain as it presents in a board will tell you how it will react to cutting. Those patterns (flat, rift and quartered) indicate where a board was harvested from a log. Riftsawn is the most difficult to predict which cutting direction will produce tearout.

Flatsawn Lumber

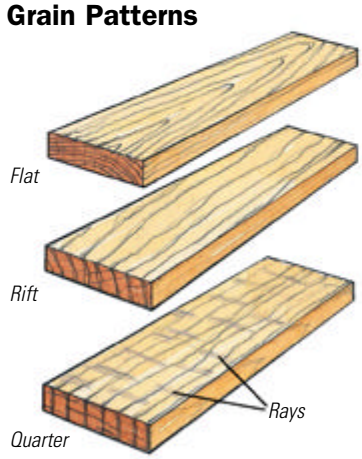
Flatsawn lumber is the easiest grain to read, and also can tear out excessively if you try to "run the piece against the grain" through a planer or jointer. The growth rings in flatsawn stock are roughly parallel to the face, though they are curved. To joint

Log End View

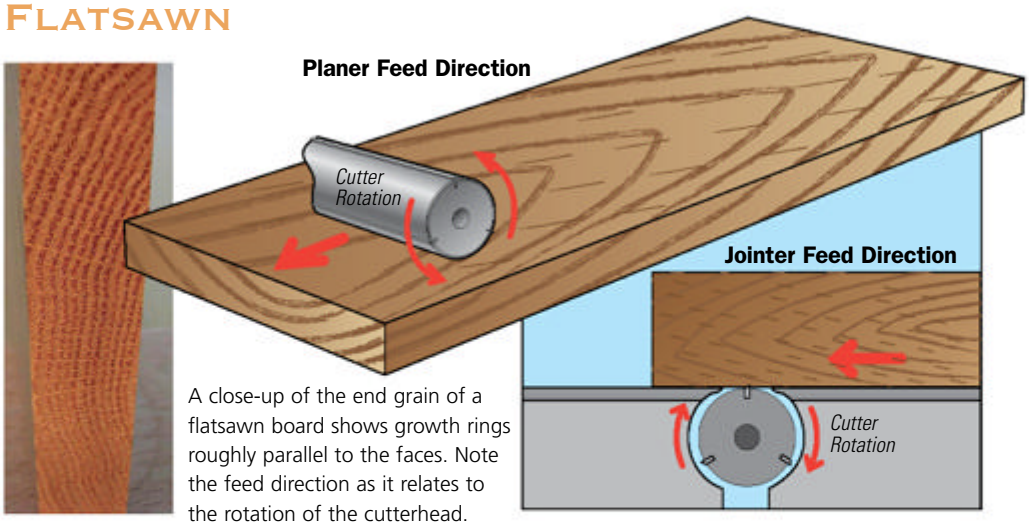


See the grain patterns as presented in boards in the illlustrations at right.

Grain Patterns

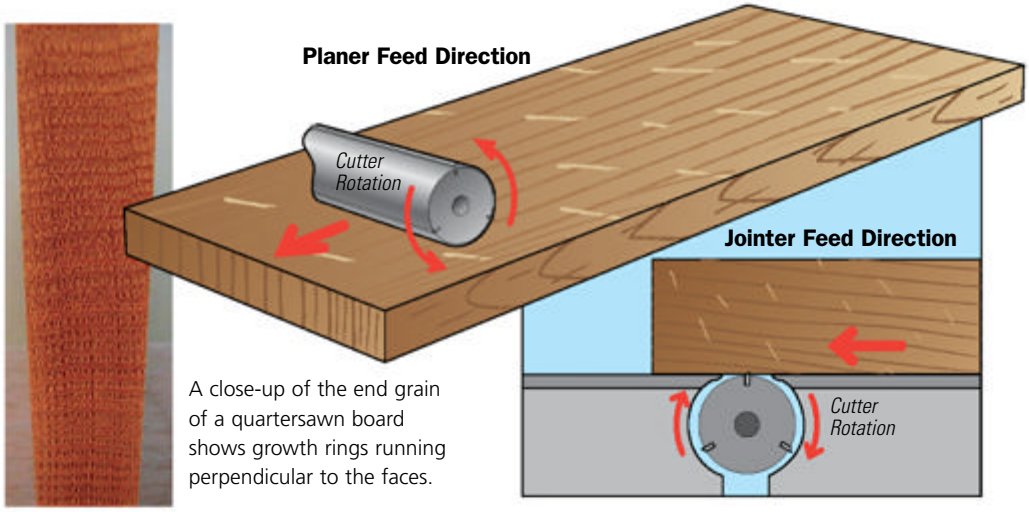


Flatsawn



A close-up of the end grain of a flatsawn board shows growth rings roughly parallel to the faces. Note the feed direction as it relates to the rotation of the cutterhead.

Quartersawn



A close-up of the end grain of a quartersawn board shows growth rings running perpendicular to the faces.

or plane the faces, it's best to read the growth ring lines on the edge closest to the center of the tree. Woodworkers say that you always want to "cut uphill" on those lines. See the top illustration to clearly understand what that means. All machines cut against feed direction, meaning that you must be aware of the rotation of the cutterhead when using a jointer or planer. To mill the edges, read the direction of the rays on the face. Read them near the center of the cathedral patterns and remember that you should never read the cathedrals themselves.

Reading the rays on the face is easy on species like oak, sycamore and beech. It's harder to read on species like maple and cherry, but still possible. On open-grained but diffuse porous species like mahogany and walnut, read the coarse cell structure on the face. And on softwoods like pine and spruce, you can read the resin canals, if the species has any. With practice, you can accurately read the grain at least 95% of the time. Always test your choice by taking a very slight cut, and if tearout happens, flip the board the other direction and try again.

Quartersawn Lumber

Quartersawn stock is the opposite of flatsawn, in that the growth rings run perpendicular to the face. Again, think of a spider web, where the concentric rings are like growth rings and the radial lines are like the rays. So evaluate quartersawn stock in the opposite way to flatsawn stock. To cut the faces, look

Riftsawn grain patterns present the most challenging figure for predicting tearout during a planing or jointing operation. The good news is you have a 50/50 chance at getting it right!

at the edges. The edge closest to the center will have tiny cathedral patterns (if properly quartersawn), but read the tiny rays running through them instead. To mill the edges, read the growth ring lines on the faces. Look to the bottom illustrations, previous page, to understand the proper feed direction and cutter rotation.

Riftsawn Lumber

There is no clear-cut way to read riftsawn stock consistently because we do not see a proper cross-sectional view anywhere on the faces or edges. However, if a board is riftsawn on one side but gets closer to flatsawn on the other side (nearer the center of the tree), that is a key. In other words, by reading in the right places you can treat the board as flatsawn if it is close to flatsawn in one area. If, on the other hand, the riftsawn board starts to become almost quartersawn on the other side (the outside of the tree), then look to the growth rings on the face but really close to the edge which would have been the outside of the tree. And treat it as quartersawn. This is more difficult, so you have to stay on your toes.

On riftsawn boards where the growth rings on the end grain are 45 degrees to the faces and edges everywhere, it's more difficult. In that case, read both rays and growth rings on both faces and edges. Where rays and growth rings run the same direction, you'll read the grain correctly for sure. Where they run in opposite directions, you're really just flipping a coin. Try light cutting in one direction to see how the wood behaves.

Worth the Effort

The fact is that we always have a 50/50 chance of making the right or wrong choice, but that does not reduce the value of reading the grain. Incorrect feed direction can and will cause tearout at the worst possible time. So just because some stock may be hard to read correctly doesn't mean we should abandon the practice altogether.

I haven't even talked in this short article about situations where the grain reverses direction once or twice or even more in a single board. In that situation, the best course is to cut according to what the largest amount of the grain indicates is the best feed direction. And where you observe that you have grain that twists profoundly or reverses within the length of the board, use extremely shallow cutting passes (and extremely sharp cutting edges).

Some high-figure grain patterns, such as bird's-eye and curly figure (e.g., maple) involve constantly reversing grain, and there is often no risk-free way to proceed. Quilted maple, crotch-grained mahogany and waterfall bubinga are some other grain patterns that will present this problem. Again, shallow cutting passes will be helpful, but shifting to scraping or sanding methods (including thickness sanders) will be most successful. Helical cutterheads will also help enormously. When using hand planes, use very high cutting angles.

Reading the grain will save you time and frustration. It is something every woodworker should learn to do. The good news is that you will get better at it if you practice it often.

Hendrik Varju is a contributing editor to Woodworker's Journal.

Adjustable Shop Horse

ADJUSTABLE HEIGHT MAKES A WORKSHOP STEADY EDDY EVEN MORE PRACTICAL.

Everyone needs sawhorses, and I'm certainly no exception. While I have several sizes, the pair I'll be describing here are adjustable in height, ranging from 24" up to nearly 35". They have nesting posts joined with sliding dovetails. The outer elements are mortised into the trestle feet. The inner elements are attached to a beam and are joined to a wide stretcher with crossdowels and connector bolts. The outer elements are similarly joined to a narrow stretcher.

Begin construction with the feet. Each foot is made by glue-laminating two plies (pieces 1 and 2). You cut a half-lap across each piece, and when they are glued up, the laps form a through mortise.

Shaping the Feet

To produce the shape, I routed an instep on each foot blank, then band-sawed the rough contour and template-routed to final shape. Only after this work was done did I glue up the feet.

The instep is a simple cut on the router table, but it does take several passes to complete each part. Use a 1"-diameter straight bit. Raise it about 7/8", and set the fence so about half the bit is exposed. Clamp stops to the fence to give you starting and ending points for the cut. To limit the amount of material removed on each pass, use a series of removable shims until you are routing right up against the fence.

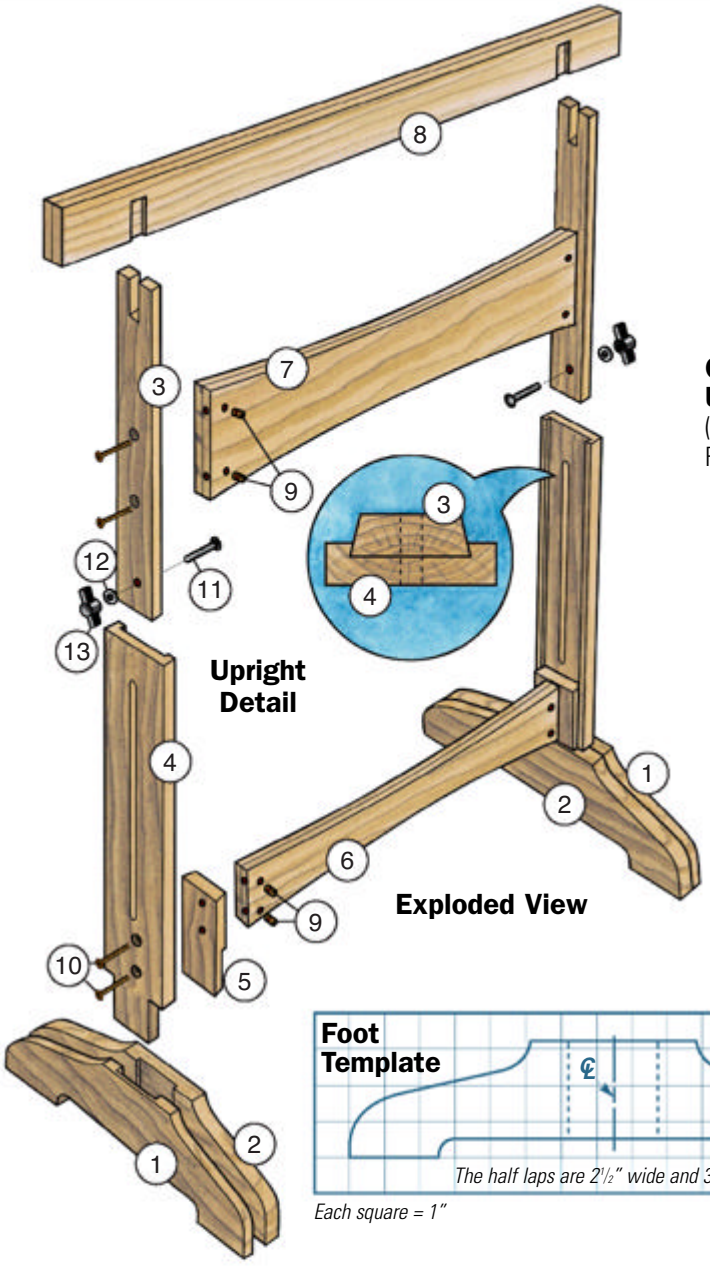
To contour the foot blanks, make a template to which you can clamp the workpieces with toggle clamps. The template need have only the right-hand portion of the overall contour: so when you rout, you are moving from ankle to toe, and the cutting edges are "laying down the grain." That's a clean, problem-free cut. To complete the shape, flip the workpiece over and rout the second half of the blank, again moving from ankle to toe.

Template-rout the contour of the foot plies. The author's template has locking clamps to immobilize the workpiece.

Making the Uprights

The uprights (pieces 3 and 4) are made up of two pieces, joined with a sliding dovetail. See the *Elevation Drawings* for the details. The strips that are to be the inner (or narrow) uprights are crosscut roughly 6" overlong. Bevel their edges on your router table. The matching groove is plowed end to end

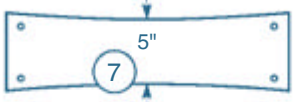
Using an edge guide to position the shallow dado in the beam ensures that all four cuts will be the same distance from the ends. The clamp secures a stop block.



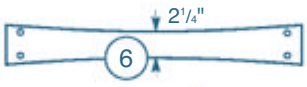
Each square = 1"

Beam
(Front View)

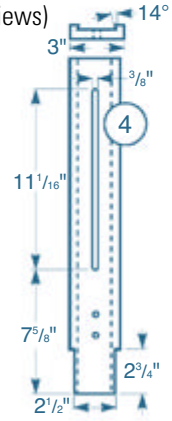
Upper Stretcher
(Front View)

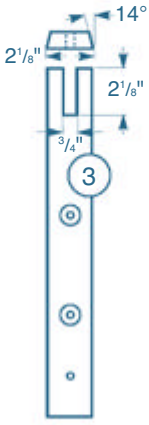


Bottom Stretcher
(Front View)



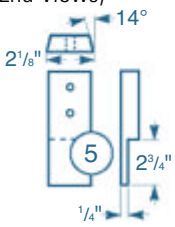
Outer Upright
(Top and Front Views)





Inner Upright
(Top and Front Views)

Upright Insert
(Top, Front and End Views)



Material List

		T x W x L
1	Thin Foot Plies (4)	3/4" x 3¼" x 18"
2	Thick Foot Plies (4)	1" x 3¼" x 18"
3	Inner Uprights (4)	3/4" x 2⅛" x 16⅞"
4	Outer Uprights (4)	3/4" x 3" x 20½"
5	Upright Inserts (4)	3/4" x 2⅛" x 5¾"
6	Bottom Stretchers (2)	3/4" x 3" x 22"
7	Upper Stretchers (2)	3/4" x 6" x 22"
8	Beams (2)	7/8" x 3" x 31½"
9	Cross-dowels (16)	3/8"-Dia. x 5/8", 1/4"-20
10	Connector Bolts (16)	1/4"-20 x 2¾"
11	Carriage Bolts (4)	3/8" x 2"
12	Fender Washers (4)	3/8" I.D.
13	Ergo-style Wingnuts (4)	3/8"-16

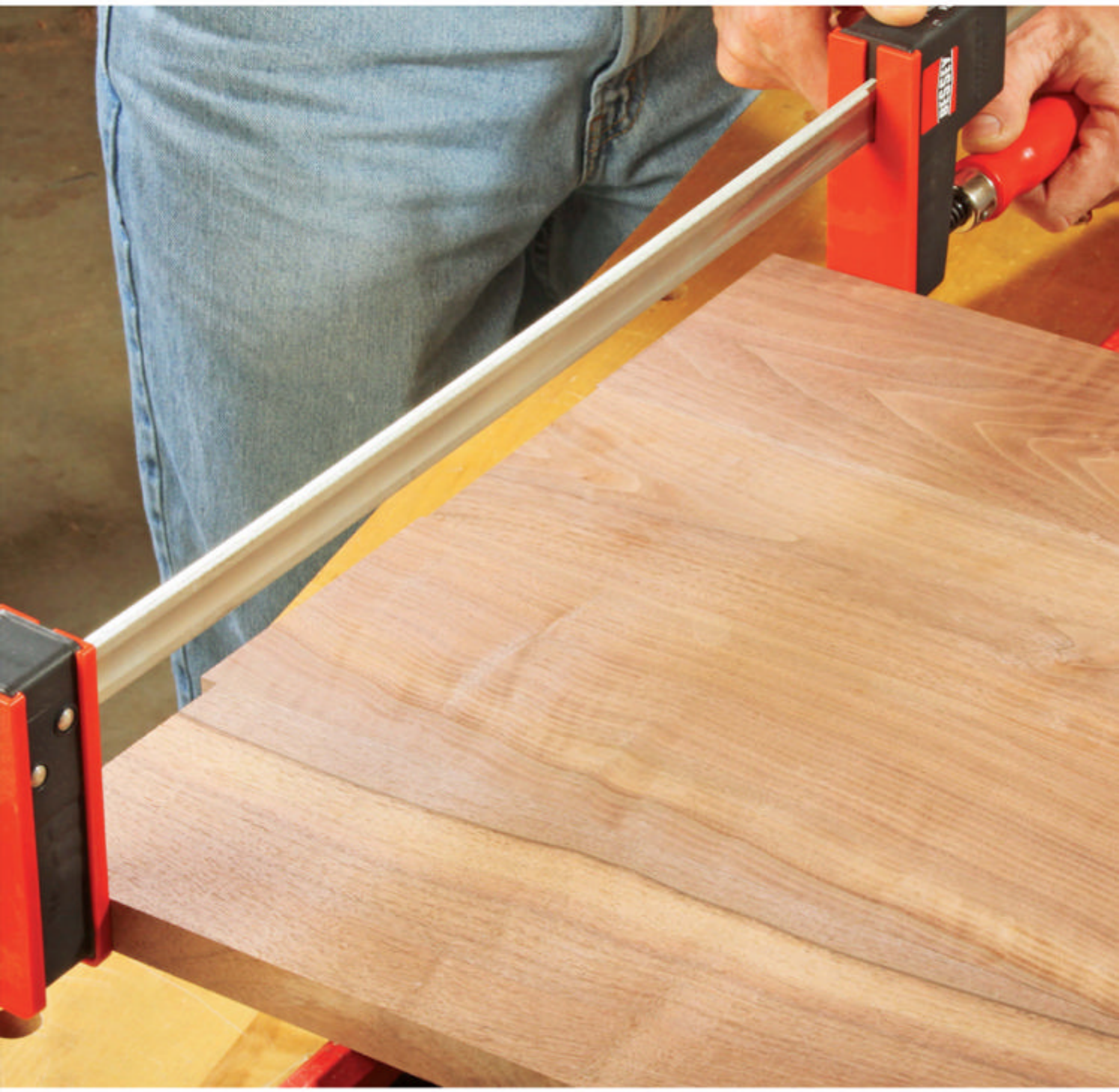
in the outer (or wide) uprights. Then 5¾" lengths — the upright inserts (pieces 5) — are crosscut from the narrow uprights and glued into the grooves. Form the adjustment grooves and the barefaced tenons on the outer uprights. Go ahead and machine the stretchers and the beams at this time. The final task is to cut the slot for the beam in the tops of the uprights.

Assemble the feet and uprights without glue, then lay out the connector bolt holes in the uprights and stretchers. Dismantle these assemblies to drill the holes. Then glue up the feet and uprights. Bolt the stretchers to the appropriate uprights, and slide the inner assembly into the foot-and-wide-upright assemblies. Use the appropriate hardware (pieces 9 through 13) to assemble each horse. All that remains is to rout shallow dadoes in the beam and to set it into the slots in the uprights. Tally ho!

Bill Hylton is a contributing editor to Woodworker's Journal.

Pointers for Making Panels

TRY THESE SIMPLE TIPS TO IMPROVE YOUR PANEL-MAKING SUCCESS.



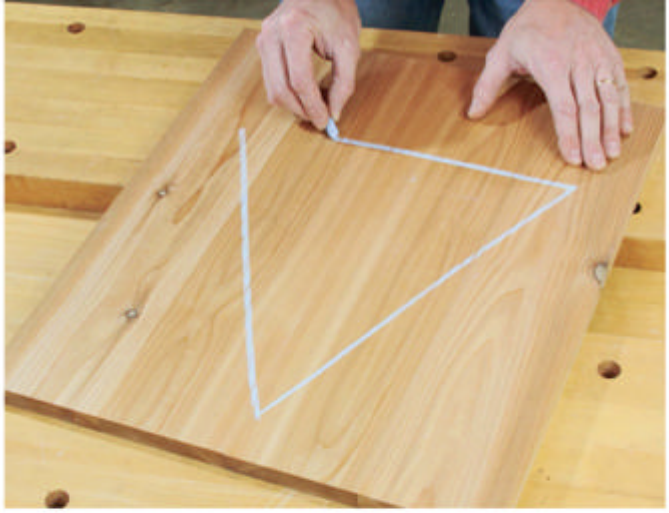


Photo 1: Once you find a visually pleasing arrangement of the panel's boards, mark them in some way to keep the order clear.

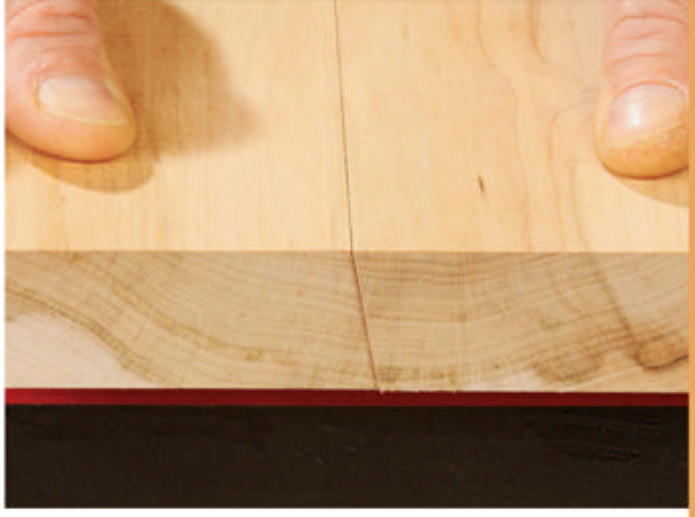


Photo 2: As long as both edges of each joint are supplementary, they will meet in a perfectly aligned glue seam.

A well-made panel should be flat, sturdy and have an overall grain pattern that looks like it grew that way. Achieving these goals takes thoughtful assembly and good technique. Here are a few suggestions that can help.

Make Your Mark

Before you even reach for the clamps and glue, spend some time composing the look of your panel. This should take place after you've jointed and planed the stock faces flat. Here's your chance to flip the pieces around, set them next to one another in various configurations and find the presentation that looks best. Try to blend the grain patterns where the edges meet so hard lines or variations in color aren't the first thing you notice. Sometimes you may need to try every arrangement under the sun before you land on the best compromise, but it's worth the effort. Don't worry too much about that old standby of alternating the end-grain patterns. Unless your boards are really wide, this practice won't contribute much to flatness over time. Once you find a pleasing arrangement, mark the parts so you can keep their orientation clear (see Photo 1). You can draw a triangle or hash marks across the joints, use pieces of tape, or whatever method works best for you. The point is to avoid confusion about how the parts go together when you're gluing them up.

Remember Geometry Class

Ideally, the edges between boards in a panel should meet at perfect 90-degree interfaces. In truth, that often isn't the case. Your jointer fence may be a quarter or a half degree off of square, but it really doesn't matter. As long as the two angles between the workpieces are supplementary — add up to a total of 180 degrees — you'll get a matching glue seam (shown in exaggeration in Photo 2). The way to ensure this is simple: When you're jointing adjacent edges, don't present the same faces of both boards to the jointer fence. Flip the second board to the opposite face instead to create the perfect mating edge.

Photo 3: Spread glue along the contact faces of both sides of a joint — not just one. This improves the glue's adhesion.

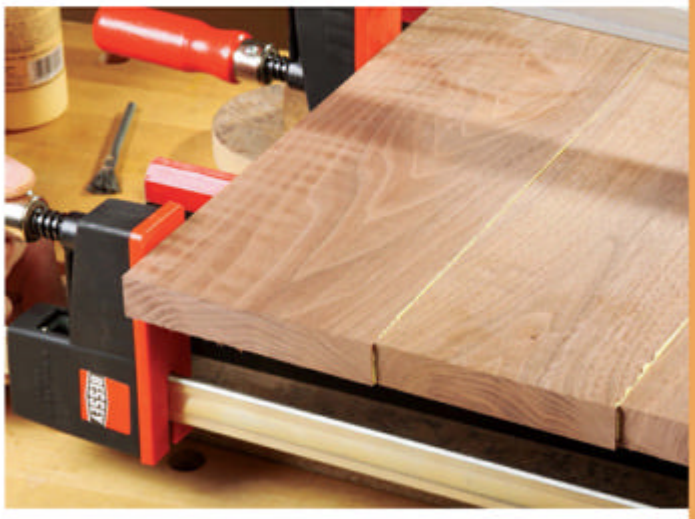


Photo 4: Tighten clamps gently and in stages at first, to give excess wet glue time to squeeze out of the joint.

Photo 5: As soon as the clamps are tight, inspect your panel's flatness with a straightedge to check for any distortion.

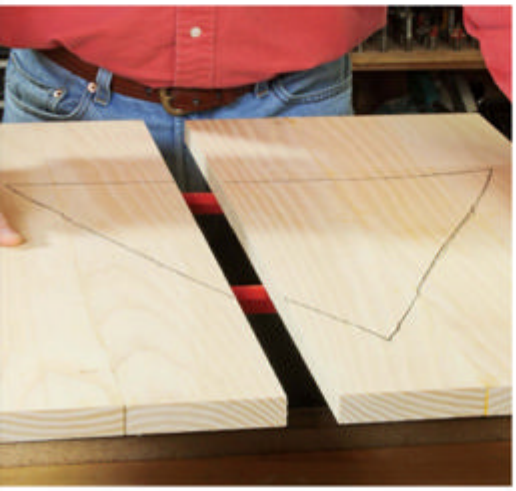


Photo 6: For really wide panels, glue the pieces together in several narrower sub-assemblies first, to make things easier.

Photo 7: Leaving unglued workpieces a bit thicker than necessary can allow you to plane the glued panel perfectly flat.

It's Good to be Two-faced

Keep two things in mind when you're gluing edges together: Glue needs to penetrate into the pores of both sides of a joint, and it sticks best to itself. Your joints will be much stronger if you apply a bead to both edges — not just one — and spread it evenly (see Photo 3, previous page). A thin coating between the contact surfaces is all you really need for good adhesion, but don't make glue-ups a one-sided affair.

Slippery When Wet

Before glue begins to set up in a joint, you've probably discovered that it acts more like a viscous lubricant than an adhesive. It takes a little time for the excess to squeeze out of the seams. When you're applying clamping pressure, tighten them in stages, starting at the middle of the panel and working outward. Apply just enough pressure at first to hold the clamps in place while the extra glue is escaping (see Photo 4). If you squeeze too tightly too fast, the boards will slip right past one another. Some amount of movement is bound to happen, no matter how carefully you apply clamping pressure, but it's easier to push the edges back into alignment when the clamps aren't drawn fully tight.

Check Your Progress

Clamping pressure needs to be distributed evenly through the panel in order to keep it flat. Usually, the best way to do this is to alternate the clamps above and below the panel. Still, a panel can distort if the clamps are tightened unevenly. Before the glue begins to set, check for overall flatness with a straightedge (see Photo 5). If the panel is beginning to cup in one direction or the other, loosening the clamps slightly in the direction of the cup can often correct the situation. Now is the time to fix a potential problem while you still can.

Break It Down

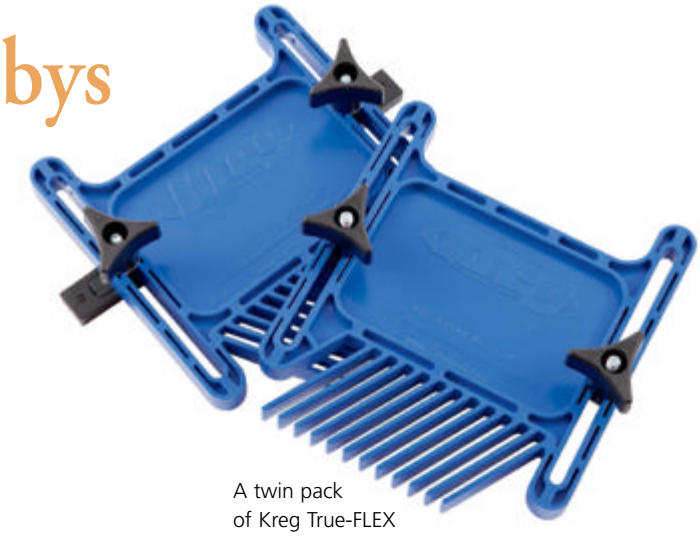
When you're creating a wide panel from a bunch of narrower boards, it can be stressful to juggle too many "wet" glue joints at once ... boards are slipping and sliding, clamps are shifting, and the glue is beginning to cure. It doesn't have to be that way. The simple solution is to glue the panel together in narrower sub-assemblies first. Limit each of these to just two or three boards. Once the sub-panels are dry, you may only have one or two joints left to bring the whole panel together (see Photo 6).

Faster Way to Flush

Even after careful assembly, some amount of scraping, sanding or hand-planing is typically necessary to level all the joints perfectly. Here's a trick that can save some of this clean-up time. If the final width of the panel will still fit in your planer after assembly, leave the stock 1/16" or so thicker than necessary when you initially prepare it. Once the glue is thoroughly dry (allow at least 24 hours), run both faces of the panel through the planer again, setting it for light cuts (see Photo 7). Be sure to first remove any excess dried glue with a scraper, to save wear-and-tear on your planer knives.

Kreg Tool includes both T-bolts and wedge-action blocks, so you can use these featherboards on T-track fences as well as miter-slotted tables.

Seven Shop Standbys



A twin pack of Kreg True-FLEX Featherboards provides versatile and reliable service for our author.

What are your "tried-and-true" tools? Here are seven of our senior editor's favorites.

This article came about as a question from my boss: "What tools would you absolutely not want to be without?" He was hinting at a "deserted island" scenario. And, it was a good muse, because it's made me search the shop for those tools that really deliver, project after project, as opposed to others that are either used less often or basically ubiquitous. Good tools stand out on their own. Here are seven of my favorites.

Kreg True-FLEX Featherboards

Power tool shops need featherboards for accurate and safe machine setups, and Kreg Tool Company's True-FLEX™ Featherboards are top-notch. I like the long adjustment slots on their composite plastic bodies, which offer 5 inches of travel from a miter slot, to handle either narrow workpieces close to the cutter or wider material. Their flexible feathers offer just the right amount of "give," so it isn't a chore to push wood through a bit or blade, but they still stand firmly against backward motion during a cut.

But the real beauty of these blue ones is how they mount to a machine: you get a pair of T-bolts, plus plastic blocks that fill a standard 3/8" x 3/4" miter slot. Use just the T-bolts for a T-track fence, or slip the plastic blocks onto the T-bolts to set them up for miter slot use.

BESSEY K Body Revo and Revo Jr. parallel jaw clamps offer many advantages over garden-variety pipe clamps. They'll provide sure clamping force for assembling all manner of panels, carcasses and door frames.

The blocks wedge tight in the slot and do not move when you secure the featherboards down. It's nice to be covered for any application with one purchase.

In that regard, while you can buy them individually, I'd suggest you get the twin pack (around $35): you'll want to have two featherboards on hand for many operations.

BESSEY K Body Clamps

Whenever I'm gluing up panels, carcasses or cabinet doors, I grab my BESSEY K Body® Revo™ or Revo Jr. parallel jaw clamps before I even get out the glue bottle. They are an essential part of both the dry-fitting stages and the glue-up process.

Pipe clamps are cheaper, there's no question about it, and I use them, too. But the black pipe can distort under pressure, and the jaws don't stay parallel. That's not an issue with BESSEY's Revos, because their bars don't deflect and the clamp heads are always aligned. I like the plastic clamp head covers, too: glue won't stick to them, and they help prevent accidental marring. The classic K Body Revos — BESSEY's premium option — offer more clamping pressure than the more economical Revo Jrs., which have only been out for a few years. But, for typical glue-ups, I haven't needed more clamping force than the Revo Jrs. will provide. In fact, their lighter weight makes them even easier to handle.

How many parallel bar clamps does a woodworker need? It's hard to say, because so much depends on the kinds of projects you build. But, if you're just starting out and gathering a clamp collection, eight to 10 in the 24" or 36" size will serve you very well indeed. For wide panels, such as tabletops, I tend to use pipe clamps instead. Panels that exceed 36" wide just aren't that common for me, in order to justify the extra cost of really long bar clamps.

Helical Cutterheads

I love my Powermatic 15" HH planer. Aside from its battleship-tough build quality and wide capacity, the biggest virtue of this machine is what gets the cutting done: it has a helical cutterhead with 98 four-sided, indexed carbide

Helical cutterheads with four-edged, carbide inserts ensure smooth cutting and hassle-free maintenance for both surface planers and jointers.

inserts. In the seven years that I've used this planer, I've rotated all of those little inserts just once for sharpness and a few of them a second time to remedy nicked edges. That's all I've needed to do to keep it cutting smoothly.

Insert cutterheads are the best thing that's happened to surfacing machines in decades. If you've ever spent a Saturday trying to adjust standard knives to top dead center, a helical cutterhead reduces that maintenance to a fraction of the time with no hassle. Really, you can't get it wrong: loosen a screw, twist the insert to a fresh edge, and tighten the screw.

Cutting performance is wonderful, too, even on reverse grain or figured woods. And, if you forget to keep an eye on grain direction, the shearing action of the inserts is usually very forgiving. When it's time to invest in a new planer or jointer, I can confidently say, helical is the way to go.

Rockler Glue Brushes

The best way to spread glue is with a glue brush, not your fingers. I used to use those inexpensive plumber's flux brushes, but the thin steel handles rust and the bristles would fall out. Then along came Rockler's silicone glue brushes, and I started using them instead. I haven't looked back since. You've probably heard the hype about dried glue just peeling off the soft, spaghetti-style bristles, but it's true. PVA, polyurethane, hide glue and even epoxy lift out easily, once they fully cure. I've tried all the glues to see for myself. But the real reason I like them is it gives me a license to be lazy: there's no need to wash glue brushes anymore. I just pull off the honeycomb crust of dried glue, and the bristles are clean.

Rockler has expanded this line to include a mini brush, a flexible spreader, silicone glue tray and, most recently, several paddle styles. But the $5 original brush is still my favorite choice.

Rockler's silicone gluing accessories last longer and are easier to clean than typical flux brushes. Dried glue peels off.

Freud SD508 Dado Blade

Five years ago, I tested some of the best 8" dado sets our industry offers, and this Freud blade tied in a dead heat with two other premium blades for our "Best

We rated Freud's SD508 Dado Blade a "Best Bet" in recent testing, and our author has relied on its clean-cutting performance for more than 10 years.

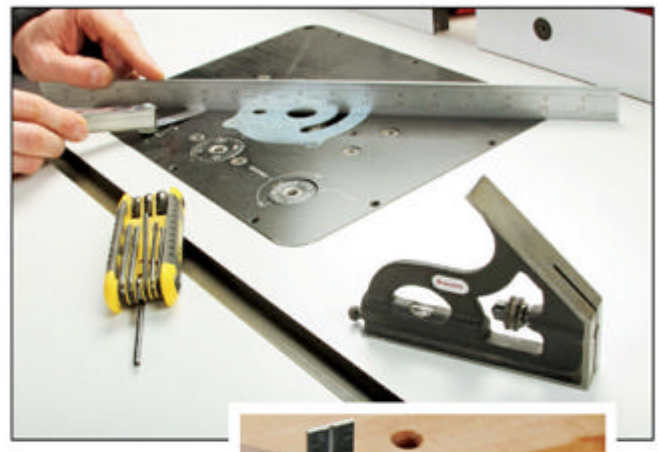
Bet" honors. I gave it perfect scores for clean cross-grain cuts in both maple and cedar; I had to search hard to find any evidence of chipping in melamine or splinters in oak plywood. They were tough cutting tests.

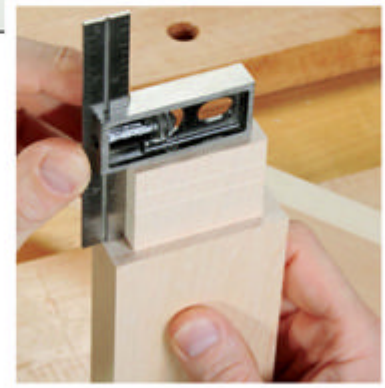
Its six chipper blades and two outer blades all have anti-kickback nubs for safety. Stack it all together, and the SD508 will cut to 29/32" wide. You get a set of metal shims and a plastic case for just under $200: a fair price.

Truth be told, I expected this Freud dado blade would test well against the rest, because it's been my go-to dado blade since about 2003. Through the years, it has really shined for me, retaining sharpness for so darn long, regardless of what I cut or how often I use it, which is frequently.

I have a few other dado sets I could use too, but they sit on a

Festool's TS 55 REQ Track Saw offers arrow-straight cutting when used in conjunction with a guide rail. Its splinter guard, riving knife and superior dust collection set it apart from ordinary circular saws.





Starrett is a brand name synonymous with accuracy. The company's combo square, rules and 4" double square are reliable companions in our senior editor's shop.

dusty shelf. Why? Not because they're inferior, but because this one cuts flat, clean dadoes every time. The others can wait.

Festool TS 55 REQ Track Saw

Many will ask: Why does any hobbyist woodworker need a $615 circular saw? Can you imagine how often the folks at Festool have heard this exact question? Then the skeptics try one and become believers. It happened to me, too, many years ago.

Consider for a moment the economics of cabinet-grade plywood. Premium lumber core plywood can sell for more than $60 per sheet. Add a figured veneer to it, and $100 sheet goods are not out of the question. When I'm breaking down quality materials like that, I don't want even one cut to feel like I'm just "roughing it." Festool's TS 55 REQ, or the larger TS 75, mounted on one of their guide rails, will ensure that so-so cuts don't happen. Ever. You can adjust the saw for zero play along the rail, and a splinter guard supports the top face of the plywood veneer so it will be cut as cleanly as the bottom face. Cuts are straight and crisp.

Then there's its dust collection capabilities. The engineers at Festool have no tolerance for dust, and when connected to one of the company's dust extractors, you won't see a cloud of fine dust rising with every cut. There will scarcely be dust at all. That's saying a lot for a tool that looks quite a bit like an ordinary circular saw.

I mainly use my TS 55 REQ for sheet goods, but it's also very handy for straight-line ripping crooked or waney edges on solid stock. For that work, I switch to a ripping blade and use the same guide rail. If I was ever left without a table saw (heaven forbid), I think I could get by for most cutting needs with just this tool. It's money well-spent.

Starrett Combo Square

If you ask 10 serious woodworkers what brand of combination square they use, I'll bet nine of them will say Starrett. L. S. Starrett has been making precision measuring tools for 138 years, and they stake that legacy on machinists' accuracy.

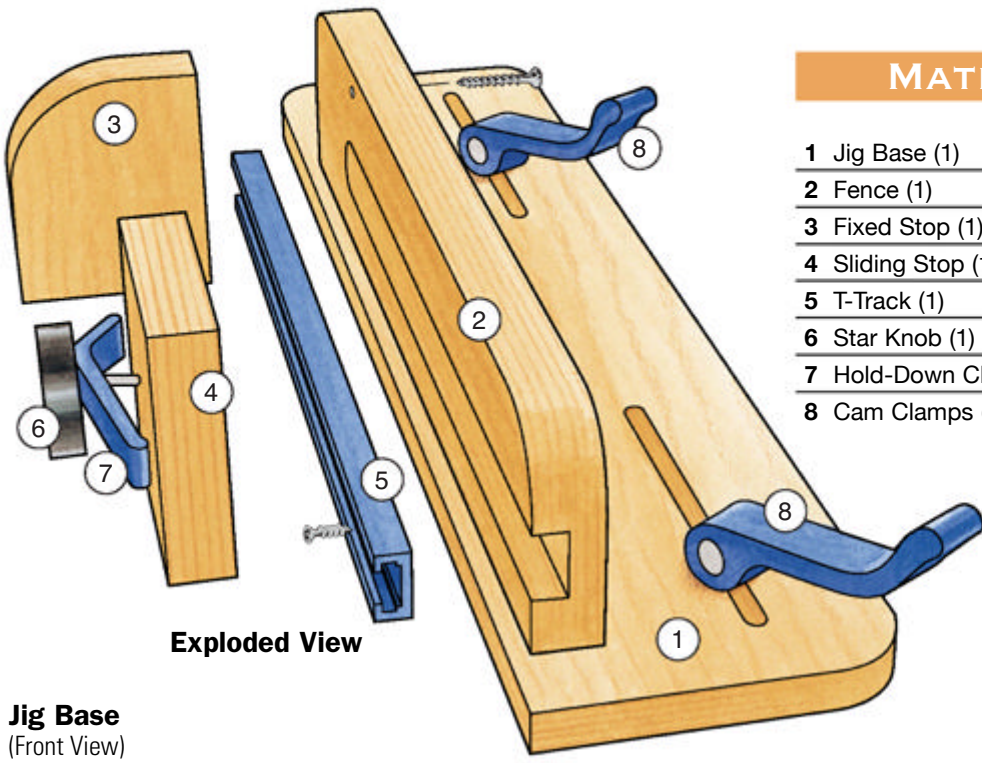
What does that matter to a woodworker? Well, there's confidence knowing that your workpieces are *really* square when your combo square verifies it. I use mine for dialing in machine fences, checking table saws for blade alignment, setting bit heights or making sure clamped panels are flat. The tool is always on my bench during the layout stages of a project, and it often is called upon during tool reviews. Bottom line is, I can absolutely count on this square for measuring, marking and squareness accuracy.

I use both 12" and 18" blades with the same head. I also have a 4" double square for more intricate measuring and marking. I intend to pass both on to my grandkids someday.

Give some thought to your "deserted island" tool picks sometime. It might make you appreciate them even more.

Chris Marshall is senior editor of Woodworker's Journal.

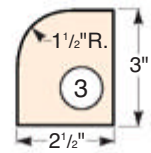
Dual Stop Vertical Drilling Jig



Exploded View

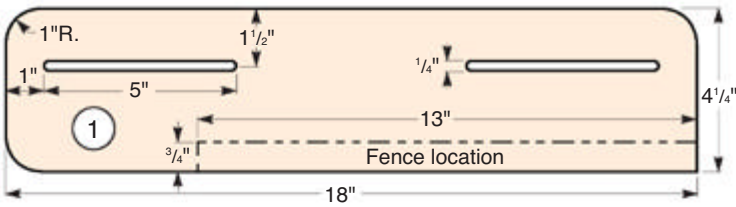
Material List

		T x W x L
1	Jig Base (1)	1/2" x 4¼" x 18"
2	Fence (1)	3/4" x 2½" x 13"
3	Fixed Stop (1)	3/4" x 2½" x 3"
4	Sliding Stop (1)	3/4" x 3" x 3"
5	T-Track (1)	Rockler #22104
6	Star Knob (1)	Included with part 7
7	Hold-Down Clamp (1)	Rockler #35283
8	Cam Clamps (2)	Rockler #58244

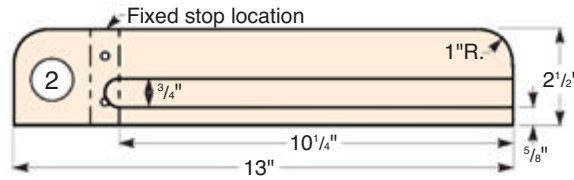


Fixed Stop (Front View)

Jig Base
(Front View)



Fence (Front View)



Nothing beats a drill press for boring perfectly vertical holes. With your stock flat on the table, you'll get spot-on verticality. However, when drilling holes into the ends of a workpiece, turning the work on-end and keeping it rigidly vertical while drilling creates a delicate balancing act. A vertical drilling jig like this one makes the process easy again.

This jig works with the drill's table to hold your workpiece vertically with a dual stop system — one affixed to the jig's 90° fence serves as the vertical register for the workpiece, while a sliding stop adjusts along a T-track to hold the workpiece upright.

Sliding stops and T-tracks go well together — a hole drilled through the stop accepts a star knob and T-bolt; slide it along the track to wherever you want it and then just snug it up. I offset the hole in the sliding block to add versatility.

For simple drilling of shallow holes, just use the sliding stop and knob by itself to orient your workpiece against the jig's fixed stop. The jig provides the vertical reference while you simply hold the piece in place. For deeper drilling (especially for things like pen blanks that tend to "get stuck" on the drill bit), add a hold-down clamp beneath the star knob. Slide the whole thing over against your workpiece and clamp everything down securely.

Because the T-bolt hole is offset in the sliding block, you can orient the long tang of the hold-down to one side or the other of the block and orient the block with the hole to the right or left, all of which provides versatility and efficient clamping power for differently sized workpieces (photos, bottom of opposite page).

Making the Jig

You can make your jig from just about any flat material, but I chose 1/2" birch plywood for the jig base and 3/4" for everything else. I've sized the jig and its components for my drill press, so you may want to adjust sizing to best fit your machine. Also, my drill press has a pair of T-tracks in the cast-iron table that I took advan-

tage of with T-bolt cam clamps, but if your drill lacks those you can also use the cam clamps with regular bolts and large washers in the open slots in your table. If that does not work, you can simply clamp the jig to your drill press table to hold it securely.

Begin by cutting the base to size and routing a pair of 1/4" x 5" slots for the cam clamps. Place these about 1½" from the back edge, and an inch from each end. (This placement and slot length gave the movement range that worked best for my drill press, but adjust yours as needed.) The router table works best for this task. Mark the router fence so the bit lines up with the slot's starting point, then mark the workpiece where you want the slot to stop. To cut the slot, line up the workpiece on the fence mark and drop the wood onto the bit. Then just slide the workpiece along the fence till you reach your stop mark, and lift the workpiece off. Repeat the process for the other slot. With that done, round off three of the corners with a band saw or jigsaw as you can see in the *Drawings* — the right/front corner of the base remains square for placement of the fence shortly.

Now, cut and round off the jig fence and mark the location of the fixed stop onto the fence face as shown in the *Drawings*. Rout a 3/8" x 3/4" dado along the length of the fence, stopping the dado in the middle of the stop location. This allows you to attach the T-track so the end is hidden underneath the fixed stop once it's in place.

Attach the fence to the front of the jig as shown in the *Drawings* with glue and screws, and then glue the fixed stop into place on the front of the assembly. Note: The fixed stop holds the key to keeping your workpiece vertical, so check for squareness as you do this glue-up. Reinforce the fixed stop with a pair of screws driven through the fence.

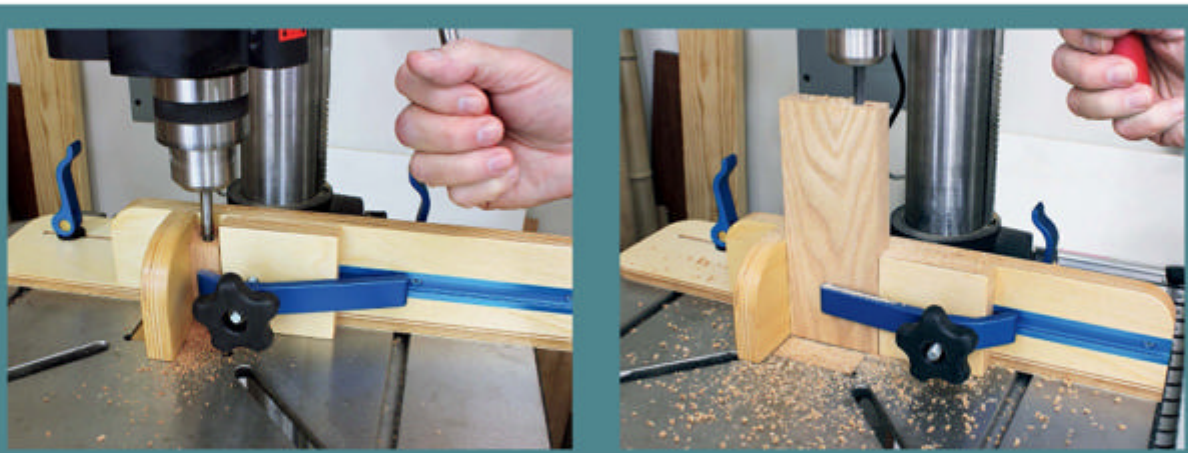
Finally, drill a hole for the star knob through the sliding stop centered top-to-bottom and about 1" from the edge.

Finish the jig if you like: two coats of polyurethane will help the sliding stop move more smoothly along the face of the fence (and make the jig look terrific).

A.J. Hamler is a contributing editor to Woodworker's Journal.

To make a routed slot inside a workpiece, line it up with your start mark on the fence. Then just drop, rout and lift on your stop mark. The location of the slots may need to be adjusted to accommodate your drill press.

By routing the dado slightly long, the end of the T-track is neatly hidden underneath the fixed stop: a nice touch. The T-track is held in place by screws driven in through prepared countersunk holes.



For more holding strength, install a hold-down clamp underneath the star knob on the sliding stop. For wider workpieces, flip the sliding stop and hold-down clamp as needed. Because the hole for the star knob is offset on the sliding stop, the blue hold-down clamp can be flipped 180° to accommodate differently sized stock. When drilling shallow holes, you can remove the hold-down to speed up your drilling.

Portable Sawmills: Lumber from Local Trees

A PORTABLE SAWMILL COULD BE YOUR TICKET TO GETTING QUALITY PROJECT WOOD AT A MORE AFFORDABLE PRICE.

A Mobile Dimension sawmill (top) and portable band saw mill (above) both cut with motorized cutterheads that ride on a track.

I was walking around my property the other day, admiring the majestic redwood trees that grow there in abundance. Although I've never seriously considered cutting any of them down, I couldn't help but imagine how much lumber each of those big trees (many are well over 150 ft. tall and 3½ ft. in diameter at the base) would yield if they were sawn. Even one or two trees could yield enough lumber for a new deck, a large shed and maybe even a kitchen's worth of cabinets (hmm…I don't suppose I'd miss just one tree…).

Evidently I'm not the only one thinking about getting lumber from local trees. Nowadays, more

A portable band saw mill transforms fallen trees or salvaged logs into beams and boards for building projects (left). The portability of band saw mills allows trees to be milled where they are cut (above).

and more woodworkers, builders and DIYers are buying and using wood that comes from local trees sawn into lumber at a local sawmill. When you think sawmill, you're likely imagining an old rustic building and a huge circular saw powered by an engine as big as a '56 Buick chewing through giant logs like they were toothpicks (sawdust chokes the air; the ground shakes). But the fact is that a lot of the lumber cut locally is produced by smaller portable sawmills.

One of the earliest portable sawmills was the Mobile Dimension Mill, an ingenious device developed in the early 1960s. It uses a Volkswagen engine to power three circular saw blades: one large vertical blade, and two smaller horizontal blades that cut just ahead of it. The distance between the horizontal blades is adjustable. The motorized cutterhead travels on a track held by two end supports that suspend it above a stationary log. With each pass, the three blades produce an accurately dimensioned piece of lumber. While very efficient and productive, circular saw blade mills are large, expensive machines not designed for the casual lumber sawyer.

Although there are other portable lumber sawing devices out there (see the sidebar, page 70), the machine that has proven to be the most efficient and versatile means of turning logs into high-quality lumber is the portable band saw mill (PBM). These ingenious machines have a motorized horizontal band saw that rides on a track over the top of a log which remains stationary as it's cut. A PBM is small enough to be loaded in the back of a pickup or be towed behind it, yet has enough power to transform even a sizeable hardwood log into slabs, beams or boards. Compared to an old-fashioned sawmill's big circular blade, a thin band saw blade requires less power to run and creates a narrower kerf, thus producing less sawdust while yielding more useable lumber from every log. PBMs are not only safe, easy and economical to run, but since they can be transported to where trees have been felled and used to saw them right on-site, they eliminate the hassle and expense of hauling whole logs to a standard sawmill.

The rigid bed of a band saw mill firmly supports a log or plank as the cutterhead travels along it to take a cut.

Professional sawyer Chuck Pyle removes the 1¼"-wide blade on his Wood-Mizer band saw mill.

A 4-cylinder turbo diesel engine provides plenty of power to cut through even big hardwood logs.

The track and bed of the economical Lumber Smith portable band saw mill are built by the purchaser.

Often referred to as "walkers" or "pushers," manual portable band saw mills have a cutterhead that must be pushed along its bed/track for cutting. This allows the user to adjust the feed speed as necessary.

At least a dozen American companies currently produce portable band saw mills. Models range considerably from smaller, simpler manual models with price tags in the low-to-mid four figures to big professional models that feature built-in hydraulics and computer controls and can cost as much as a luxury automobile. They're a popular choice for a wide range of users, including: landowners who want to turn trees on their property into sellable lumber or studs, beams and planks for building barns, sheds and fences; woodworkers looking to use locally scavenged logs for their furniture and cabinets; or anyone who wants to start a business cutting other people's logs into lumber. As the price of commercially produced lumber continues to rise, more and more folks are looking for alternative ways of getting their materials from trees they have on hand. Tree stumps, branches and logs can often be garnered from neighbors, scavenged after storms and obtained from local tree cutters or power and telephone companies who cut trees threatening overhead lines.

Not only are portable band saw mills available as new machines (customized with a wide range of options to suit the purchaser's needs), but there's a burgeoning market in used machines as well. If you don't want to invest in your own machine, there are plenty of sawyers out there who will bring their PBM to your property and saw your logs into lumber for an affordable fee. Either way, the lumber produced will be considerably less expensive than what you'd pay at a commercial lumberyard.

Portable Mill Anatomy

The heart of a portable band saw mill is a motorized, horizontally oriented band saw mounted on a carriage that rolls along a pair of rails that act as a track. The track is part of a bed with cross supports that creates a level platform for the log (or branch, plank beam, etc.) to be cut. Adjustable posts and clamps attached to the bed are used to position the log and hold it firmly in place. During cutting, the carriage rolls over the top of the stationary log as the band saw takes a cut. The

Top: Some band saw mills have an integrated trailer, for easy towing. Middle: A hydraulic clamp holds a log firmly to the bed. Bottom: The setwork's controls are used to adjust the saw's depth of cut.

height of the blade relative to the log is adjusted by moving the entire cutterhead (band saw and motor) up or down, which sets the thickness of cut. The adjusting mechanism, called the "setworks," allows adjustments to be made in very fine increments, so that the dimension of cut boards is very accurate.

The band saws on all but the largest industrial-sized PBMs sport 19" diameter wheels that run a 1¼"- or 1½"-wide blade. The distance between the wheels/blade housing determines the mill's maximum width-cutting capacity, which ranges from 24 inches to 40 inches, depending on the model. A blade tensioning mechanism and a pair of heavy-duty guides (much like those found on a regular woodworking band saw) keep the blade running straight and true during cutting — essential for obtaining flat boards or planks. When cutting resinous woods, like pine and fir, a small plastic tank and flexible hose feeds a water-based lubricating mixture onto the blade, to help keep the blade clean and running smoothly.

A PBM may be powered by either a gasoline or diesel engine, or a large electric motor (single- or three-phase). The engines/motors on smaller models range anywhere between 7hp and 30hp, while larger models that run on big multi-cylinder engines may produce 50 horsepower or more. The more power the PBM has, the faster it cuts through logs, and the better it handles dense wood species and defects, like knots or areas of tight grain, without bogging down. A more powerful band saw mill also cuts a greater number of board feet per hour, hence is more productive and cost-effective when used regularly.

The length of a PBM's bed determines the maximum length of logs that can be cut. Because the cutterhead carriage rides over the log, its track must be long enough for the carriage to clear the log at both the beginning and end of the cut. For example, Wood-Mizer's LT10 mill has a bed that's 14' 4" long and can cut logs up to 11 feet long. Fortunately, the majority of band saw mills accept bolt-on bed extensions, allowing them to handle longer logs — up to 25 feet or more. (The rock-bottom-priced Lumber Smith PBM requires users to make

their own bed and track from construction lumber, which can be built as long as necessary.)

For portability, most smaller PBMs break down into separate components, allowing the mill to be loaded into the back of a pickup truck: The motor/cutterhead carriage detaches from the track and the bed sections unbolt. Alternatively, some models have rigid beds built into wheeled trailers, allowing them to be easily towed.

Manual and Hydraulic

The main distinction between various PBM makes and models is whether they are entirely manually operated

Pyle loads a large walnut log onto the bed of his portable band saw mill, maneuvering it into place with his trusty telescopic forklift.

Hydraulically powered devices help position the log on the mill's bed before securing it.

The mill's cutterhead carriage travels the length of the bed as the band saw takes the first cut.

A hydraulic lifter is used to rotate the log 90 degrees in preparation for the second cut.

With two flat, square sides cut, the remainder of the log is sawn into accurately dimensioned planks.

or employ hydraulic power. All lower-priced economy models are manual "pushers" (also known as "walkers"). They require the user to either physically push the cutterhead carriage along its track or propel it via a hand-cranked cable (some users say they prefer the fingertip feel they get from pushing the carriage, as they're better able to gauge and adjust feed speed when cutting through knots or dense sections of a log). The setworks on most manual units employs a hand crank mechanism that raises or lowers the motor/cutterhead for setting the depth of cut (gas-filled cylinders found on some models make this operation easier). Log loading, positioning and clamping are also done manually, which requires the help of an assistant for handling all but the smallest logs. A popular option on manual PBMs is a hand-crank-style winch, which mounts to the bed and makes log loading and turning easier.

Larger, more expensive hydraulic PBMs employ a mix of hydraulic and electric power to drive various aspects of the mill's operation. Hydraulically powered cylinders operated by joystick controls are designed to handle a number of different functions, which typically include: lifting and loading the log onto the bed; positioning and clamping the log; turning and repositioning the log between cuts; and more. Electric-motor-powered chains are used on hydraulic PBMs to raise and lower the cutterhead as well as propel the carriage along the track during cutting (carriages on some models have a built-in seat that the operator rides on). When returning the carriage to its start-of-cut position, some mills have pawls that push the board or slab that's just been cut, to help offload it. All these electric and hydraulic features are designed not only to make the user's job easier; they increase the productivity of a mill tremendously. Loading, positioning, clamping and turning logs is by far the most time-consuming — and physically exhausting aspect of using a manual PBM. Using hydraulics to accomplish these tasks allows just one or two sawyers to safely cut a significant amount of lumber in a single day.

Controls for all powered functions may be mounted to the mill itself, or located on a remote console, allowing the operator to stand clear of all the noise and sawdust being produced. Computerized consoles on the priciest, most sophisticated PBMs make it very easy to control all the mill's settings and operations.

Cutting with a PBM

Before cutting can begin, any portable band saw mill —manual or hydraulic — must be set up with its bed perfectly straight and flat. Adjustable legs on the bottom of the bed are used to level and stabilize the mill on uneven ground. After the band saw's blade is tensioned and its guides are set, the log (or a large plank or beam to be resawn) is rolled or lifted onto the bed, using a loader or tractor, the mill's built-in winch or hydraulics, or by hand with a Peavey and a fair bit of muscle. The log is set against two or more vertical side supports, which help orient and stabilize

The fully cut log is placed atop a pair of spacers, then the boards are stickered and left to air dry.

it. If the log is tapered, one end must be elevated, either with shims or the bed's adjustable toe board, to orient the wood's grain more in line with the bed. One or more clamps are then positioned and engaged to firmly secure the log and keep it from moving during cutting.

With the motor/cutterhead carriage set in its starting position at the far end of the bed, the desired depth of cut is adjusted using the mill's setworks. After the motor or engine is started up, the clutch is engaged to transmit power to the band saw. The carriage is then propelled forward until the blade has cut through the full length of the log. With the clutch disengaged, the slab or board is removed, and the carriage returned to its starting position. If the log is to be cut into slabs, the depth of cut is reset and subsequent cuts are taken. Whether the mill is entirely manual or computerized, the setworks has some kind of indexing device to make it easier to set cutting depth for common board thicknesses (3/4", 1½", etc.) A scale mounted on one of the carriage support posts shows the blade's overall elevation relative to the bed.

If the end goal is to cut the entire log into lumber for construction or furniture, the first cut (or cuts) must remove enough of the log's bark and sapwood to create a smooth, flat surface. The log is then rotated 90° or 180°, via muscle power or the mill's hydraulic log turner, so that another flat surface may be cut either parallel or adjacent to the first one. Sometimes, this process is repeated until all four sides of the log are flat and square relative to each other, allowing the log to be cut into fully dimensional boards or beams.

After cutting is complete, the freshly cut lumber is offloaded and stacked in the order the boards came from the log. Spacers set under the pile keep the wood off the ground, while stickers placed between the boards allow air to circulate while the wood dries.

Sandor Nagyszalanczy is a contributing editor to Woodworker's Journal.

Chainsaw Milling Attachments

If you don't have the space or budget for a portable band saw mill, you can still slice up that walnut or oak tree that fell in your backyard by using a chainsaw fitted with a milling attachment. Chainsaw mills such as the Granberg "Alaskan" mill, which sell for between $140 and $250 (not including the price of the chainsaw) provide the most economical way to cut lumber from logs. Their compact size and light weight make them extremely portable, allowing users to cut logs in mountainous or wooded areas that lack any road access. On the downside, a chainsaw mill makes a rougher cut and removes a thicker kerf than that produced by a portable band saw mill.

A chainsaw mill attachment mounts to a regular chainsaw that's been fitted with a longer bar and special rip chain designed to cut

efficiently with the wood's grain. A pair of rails on the attachment ride against the log to guide the saw across the log at a consistent depth of cut. A flat board or metal bar temporarily attached to the log guides the initial cut. The rails then ride on the freshly flattened surface of the log for subsequent passes.

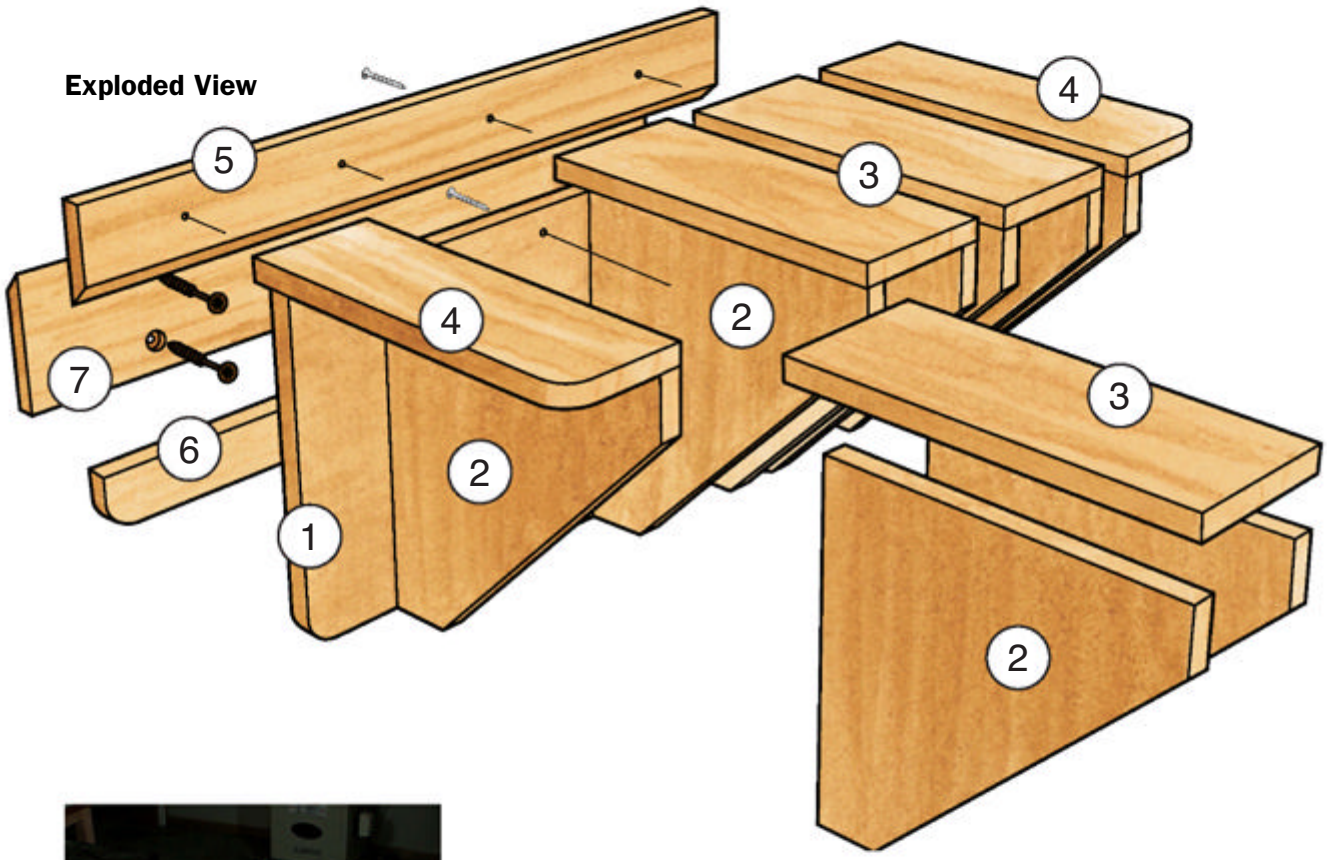
The distance between the rails and the chainsaw bar is adjustable and determines the thickness of the planks

or boards that are cut. The widest log or plank a chainsaw mill can cut is limited by both the length of the attachment's rails and the chainsaw's bar. Small mills with 18" to 36" rails use a single chainsaw and can be operated by a solo sawyer.

Larger mills with longer rails (up to 56") cut best when powered by two chainsaws, one at each end of a special bar that's made for the purpose.

Two Clamp Racks from a Sheet of Plywood

Exploded View



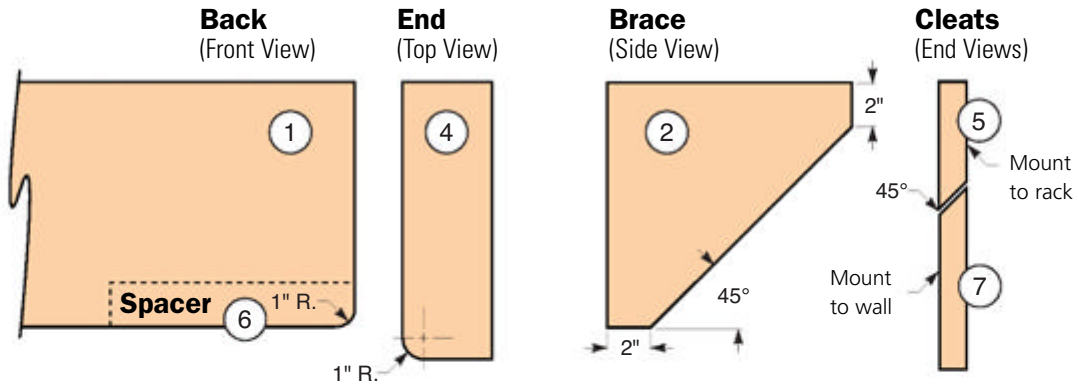
One sheet of plywood, cut carefully, will yield two clamp racks and mounting cleats.

These compact but capacious racks will keep your clamps orderly, and all you need is one 4 x 8 sheet of plywood to make them both. Each consists of four deep channels for storing rows of pipe, bar or quick-grip clamps over angled braces. Their back panels span two wall studs for strength, and the pair will shelve upwards of 80 or more clamps. French cleats make wall-mounting both sturdy and easy. It's a lot of storage for $50 or so! Here's how to make them.

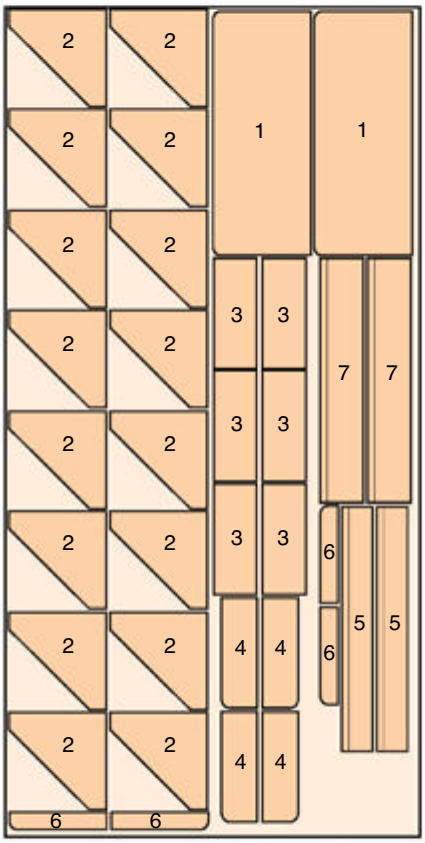
Cutting the Parts to Shape

In order to squeeze both racks from one sheet, follow the *Cutting Diagram*, above, carefully. Start by ripping the sheet into four, 11¼" x 8-ft. strips. Crosscut two 28¼"-long blanks from two of these strips to form the racks' back panels. Round the bottom outside corners of the back panels to form 1" radii.

The two remaining full-length strips are dedicated to the angled braces. First, cut them into 16, 11¼"-square blanks, then miter-cut one edge of each to 45



Cutting Diagram



Following this cutting diagram allows you to build two complete clamp racks from one 4 x 8 plywood sheet.

Material List

(Quantities listed per clamp rack)	T x W x L
1 Back (1)	3/4" x 11¼" x 28¼"
2 Braces (8)	3/4" x 11¼" x 11¼"
3 Bridges (3)	3/4" x 5" x 12¾"
4 Ends (2)	3/4" x 4⅛" x 12¾"
5 Rack Cleat (1)	3/4" x 3½" x 28¼"
6 Spacers (2)	3/4" x 2" x 11¼"
7 Wall Cleat (1)	3/4" x 5" x 28¼"

Angle-cutting the 16 braces to shape is quick and safe with a crosscut sled. Here the author secures each blank for cutting with a pair of toggle clamps mounted on fences that are attached to the sled's bed.

degrees, following the *Drawings*, above. A crosscut sled or a miter gauge with a long auxiliary fence will make this a quick job. Once those are done, cut to size the six bridges that will span each pair of braces, and make the four end pieces with one corner of each rounded to a 1" radius. Notice in the *Drawings* that each rack has a cleat attached to its back with an edge beveled to 45 degrees. It will interface with a wider wall-mounted cleat, also beveled on one edge, to lock the rack to the wall. Cut both pairs of these cleats to size, and tilt your table saw blade to bevel-rip their angled edges. What's left of your plywood sheet should be sufficient to make up four spacers. Each of them receive a single 1"-radius corner, too. Knock the sharp edges off of the back panels, braces, bridges and ends with a sanding block to prepare for assembly. That will help these rough-and-tumble racks resist splintering when you use them.

Assembly and Hanging

These racks are downright easy to put together, and that's part of their charm: one afternoon's work, and you'll be done! For each rack, fasten three bridges to six braces with screws to form three main subassemblies. Note that the top back edge of the bridges will overhang the backs of the braces by 1½". Now grab more screws to attach the four end pieces to the remaining four braces, as shown in the *Exploded View Drawing*. I used 2" counter-

Clamp and tack the bridge subassemblies to the rack back panels before reinforcing the joints with 2" countersunk deck screws. Space the bridge and end subassemblies 1¼" apart to form long slots for the clamps.

Level and fasten the wall cleats to two wall studs, with four heavy-duty screws. The author used FastenMaster's 2⅞"-long flathead construction screws (inset), which offer comparable strength to thicker lag screws.

Deep slots and extra surface areas around the rims of the edge pieces offer room for 40 or more clamps per clamp rack.

sunk deck screws and glue for assembling all of these parts. (I didn't fuss with wood finish on my racks, but it couldn't hurt. If you want the added protection, finish the parts before beginning the assembly process, while the part faces are fully accessible.)

Next, round up your back panels and brace components. Position three bridge subassemblies and two end assemblies 1¼" apart on the back panels; this slot spacing will enable you to slide 3/4" I.D. pipe clamps or the bars of most F-style clamps in and out easily. Drive a few brads through the back panels to tack the braces in place, then reinforce all the joints with more 2" screws, spaced every 4" or so.

Attach the rack cleats up under the overhangs of the bridges and to the back panels with more screws and glue — face the angled edges of these two cleats down and in toward the back panels. Fasten a pair of spacers to the bottom outside edges of each back panel to complete the building stage.

Secure the wall cleats to two wall studs, if at all possible. These clamp racks will be very heavy once fully loaded. Face the beveled edges of the wall cleats up and toward the wall before driving stout screws or lags into counterbored holes in the cleat. Then, set each rack on its wall cleat. Drive two more screws through the back panels and into the wall cleats to pin the racks in place. Now, load them up with clamps!

Chris Marshall is senior editor of Woodworker's Journal.

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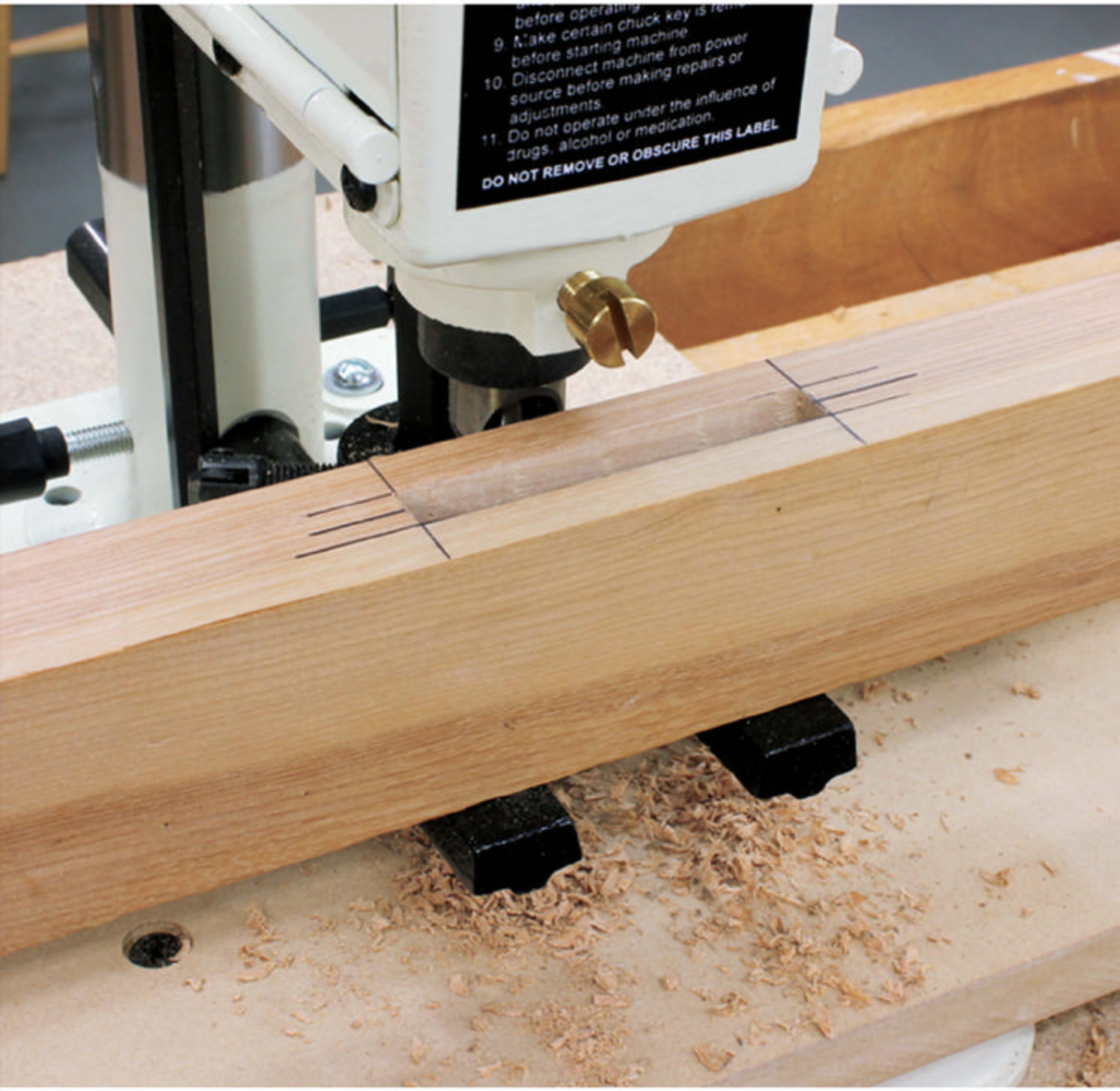
Ten Tips for Perfect Mortises

Fast and exact, a benchtop mortiser lets you turn out accurate mortise joints quickly and easily.



The guy who said you can't put a square peg into a round hole obviously never saw a benchtop mortiser. Mortisers function like a drill press (in fact, a drill bit called an auger removes most of the stock), but the bit is housed inside a square hollow chisel with sides that are really four separate chisels working as a team; as they enter the round hole created by the auger, the tips of those chisels turn the round hole into a square one. Cut a series of these square holes in a straight line and you've got a perfect mortise — or do you? As with any piece of woodworking equipment, the tool does most of the real work, but it can't do its best job unless you use it properly. Assuming you understand the basic operation of a benchtop mortiser, these 10 tips will have you churning out enviable mortises in no time.

Tip #1: Hone Your Mortising Chisels

If it's a simple fact of woodworking life that bench chisels must be sharp, then quadruple that for four-sided mortiser chisels. However, even the best bench chisels must be honed before first use no matter how sharp they come from the factory, and so do your mortiser's chisels. Start with the inner edges, using a specialized sharpener as in Photo 1. These conical hones, which often look just like countersink bits, are set at the precise angle of the inner surface of the chisel. Once the inner edges are honed, just as with bench chisels a tiny burr is typically raised on the flat side. Simply hone the flats to remove the burr — carefully; those points are sharp! — then smooth and flatten the entire outer surface (see Photo 2). Don't forget to hone your mortiser chisels periodically to keep a sharp edge.

Tip #2: Use a Dime to Set Spacing

To be effective, the internal auger must "lead" the chisel's cutting edges. A small gap not only directs chips up inside the chisel and out of the cut, but also keeps the tip of the spinning auger from creating excess heat by rubbing against the business end of the chisel. Every woodworker has a preferred distance and means of setting it, but we've found that the thickness of a dime is perfect. To set the gap, insert the chisel into the bushing on the machine, holding a dime in the shoulder of the chisel as in Photo 3. This prevents the chisel from seating all the way when tightening the setscrew. Now slide the auger up inside the secured chisel (and into the opened chuck inside the machine) until it stops, then tighten the auger's chuck. Finally, loosen the chisel setscrew, remove the dime, and slide the chisel the rest of the way up before retightening the setscrew. The auger didn't move, so it now leads the cutting tips of the chisel by the thickness of that dime.

Tip #3: Square the Chisel for Smooth Walls

Since a series of overlapping square holes creates a mortise, the chisel sides must be parallel with your workpiece or you'll get a jagged mortise. This is easy to adjust using the workpiece itself. Lower the chisel toward the table and place the workpiece against the back edge. Now bring the fence up behind the workpiece to square it. Loosen the setscrew one more time and adjust the chisel so it rests flat against the workpiece, as in Photo 4. Retighten the chisel setscrew.

Tip #4: Keep a Scrap Handy for Protection

Any time you adjust or set the chisel and auger, lift and support

Photo 1: Use a conical hone to smooth the inside concave end of the hollow chisel.

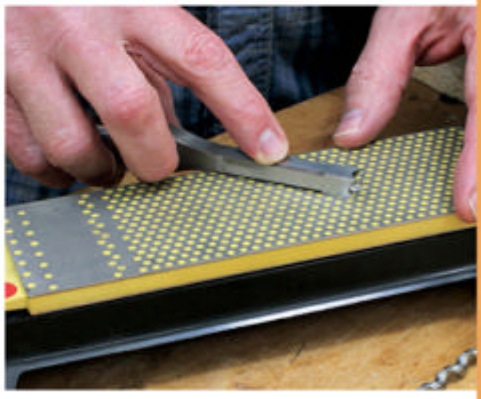


Photo 2: Remove any burrs at the cutting edges, and hone the flat outer faces smooth, with a sharpening stone.

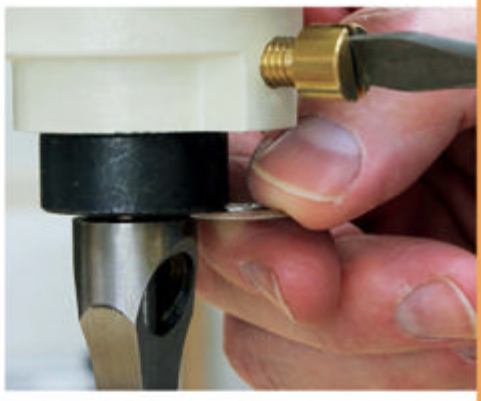


Photo 3: A dime provides just enough clear space at the chisel's shoulder to set the auger bit depth correctly.

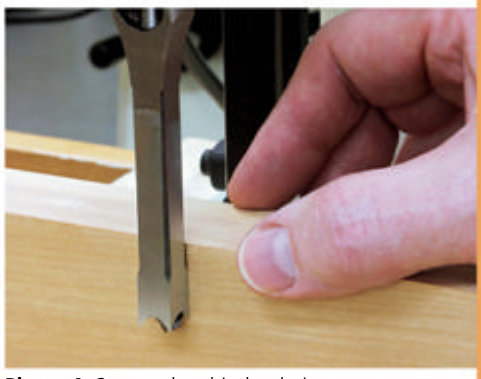


Photo 4: Square the chisel, relative to the machine's fence, using your workpiece as a backup support.

Photo 5: Set the depth of cut slightly deeper than your tenon length, which is marked on the workpiece as a line.

Photo 6: Orient the chisel's slot opening in the direction that clears debris best for you. Here, it's facing backward.

Photo 7: Cut the ends of the mortise first to define them. Then, you won't mistake the termination points.

Photo 8: Remove the waste in between the end cuts in a series of leap-frog passes. Chop out the "connectors" last.

the chisel with a small scrap of wood to protect your hands from the sharp tips.

Tip #5: Mortise Deeper than Necessary

Mortisers cut wonderful mortises, but the auger/chisel arrangement leaves the joint with a rough bottom. This is all hidden inside the joint, so it's not a problem, but you still want that bottom beyond the end of the tenon. Plus, since inserting the tenon always scrapes glue into the bottom of the joint, it's good to make the mortise a bit deeper than the tenon length to allow space for excess glue. Draw a line on the outside of the workpiece corresponding to the length of your tenons, then lower the chisel so the cutting tips go a bit beyond this line and set the depth stop (see Photo 5). Here, too, woodworkers' opinions vary, but about 3/16" to 1/4" is good for smaller joints, while 1/4" to 3/8" works well for larger ones. You can also see in this photo how the auger tip leads the cutting edges to create the small gap recommended in Tip #2.

Tip #6: Line Up the Bit's Tip, Not the Chisel

When marking out your mortise on the workpiece, include a line exactly down the center. Then, instead of trying to eyeball the sides of the chisel to line up with the mortise edges, lower the chisel till the auger tip touches that center line – the chisel sides will automatically line up with the mortise edges.

Tip #7: Try Orienting the Slot to the Back

Mortiser chisels have an open side that allows chips to exit the chisel as the auger moves them up and out of the cut. So what's the best direction to orient that opening? Opinions vary on this, too: Some put this opening on the side opposite the direction they're cutting the mortise. That way, chips fill the mortise on one side as they move toward the other. If you've outfitted your mortiser with a blower arrangement similar to one on a drill press, you might want the opening right in the front so the blower is more effective. Some like it in the back, as you can see in Photo 6. The chips build up out of the way behind the chisel, and a quick puff of breath clears the view of the cut lines in the front. Try differing opening directions till you find the one you prefer.

Tip #8: Start with the Ends

Always make the end cuts of a mortise first. These first cuts define the overall mortise length and make it easier to remove the waste between the two ends. With your fence set and the hold-down in place, line up and cut one end of the mortise; doesn't matter which one. Now slide the workpiece to the other end of your cut line. (Note in Photo 7 that with the chisel opening to the rear, the chips build up behind the chisel, keeping the front of the cut clear.)

Tip #9: Leap-frog the Intermediate Cuts

With the ends defined, begin removing the rest of the waste by making a series of plunges between the two end cuts. Space these cuts so the distance between them is less than the chisel width. Then, as in Photo 8, take out the narrow "connectors" to complete the mortise.

Tip #10: A Little Lube Goes a Long Way

Using a benchtop mortiser takes a bit of muscle, so make things easier on yourself by maintaining and cleaning all moving parts, especially the support column.

Computers in the Woodshop

Computers have entered woodworking shops in ways both bold and subtle. Here are some of the many tasks for which they can help.

Computer design programs are terrific for creating not only plans and shop drawings, but also photorealistic renderings such as the desk by California furniture maker Roger Heitzman, shown above.

Computers in the woodshop? It doesn't seem like they'd be too compatible. After all, laptops and desktop models are built in dust-free clean rooms, and the average woodshop isn't exactly the place to bring an expensive device that might be compromised by a little fine dust — never mind the bilious discharge of a belt sander!

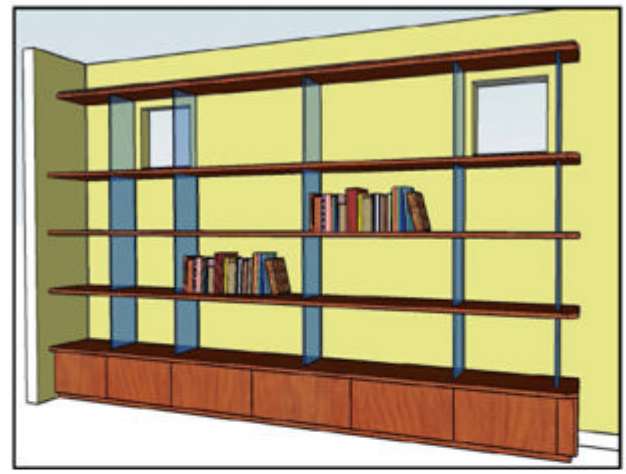
But just as computer electronics have found their way into everything from your car to your alarm clock and toaster oven, woodworkers are finding computers more useful, both in and out of the shop. There are three major ways that the computer revolution can change the way you woodwork: One is using a computer in your home office to create drawings or cut lists, create and print out plans, etc. The second is to use your smartphone, computer tablet or other device in the workshop or on the jobsite to perform duties, such as checking for level/plumb, or do calculations that help you lay out parts or set a machine for cuts. The final way is to use computerized machines either in your workshop or via online services, to actually cut out and/or shape parts, engrave or embellish surfaces, and more. There's even a new generation of "smart" machines on the horizon that promise to make standard tasks, like setting a router fence or drilling holes, safer and more precise.

Because the Internet is an expansive place and the world of software changes at a blinding pace, it's likely I've overlooked some useful apps, programs and websites (please let *Woodworker's Journal* know of your favorites that weren't included here).

Design & Drawing Programs

If you're ready to trade your pencil and paper for a mouse and computer screen, there are a huge number of ways to create a design for a woodworking or home improvement project using a computer or electronic tablet, from simply sketching out an idea to drafting a dimensionally accurate drawing to creating a photorealistic rendering (see photos, above). Programs suitable for woodworking range from basic paint and drawing programs to CAD (computer-aided design) programs to specialized cabinet/furniture design and management software. Ultimately, the kind of program you choose depends on your computer skills, your budget and the time you want to devote to learning the necessary software; design software can be expensive and require lots of time and patience to master. If you're not particularly computer savvy and are intimidated by all the available choices, a good path to follow is to choose design software based on your design goals:

- If you just need to draw the shape of a part or project, such as the outline of a turning or a loosely sketched design of a chair, dresser, etc., a basic free or low-cost paint/drawing program such as Krita or MyPaint is relatively easy to use and can produce good results. To create wood parts from a sketch, simply print out your design full-size, paste it atop your workpiece and use it as a template to cut the part out.
- To create drawings or plans to use to build a project, choose a basic CAD program, such as CadStd Lite or JustCad 10.0. Both of these free programs (for Windows operating systems) let you create and print out accurate two-dimensional drawings of cabinets, furniture, floor plans, construction details and more using standard drawing



Computer-aided design (CAD) programs are terrific for creating all kinds of furniture, cabinets and DIY projects. Basic programs generate basic plans, elevation views and shop drawings, while 3-D programs let you visualize your project from any viewing angle. Some programs feature object libraries that let you create, say, a kitchen by simply dragging and dropping cabinets into place.

tools like lines, rectangles, arcs and circles (see photo, above) you render and manipulate on-screen with your computer's mouse. More complex curved shapes take longer to draw, but are also possible. Most of these programs can save designs as .dxf files, which may be used to create parts with CNC lasers and routers (see sections below).

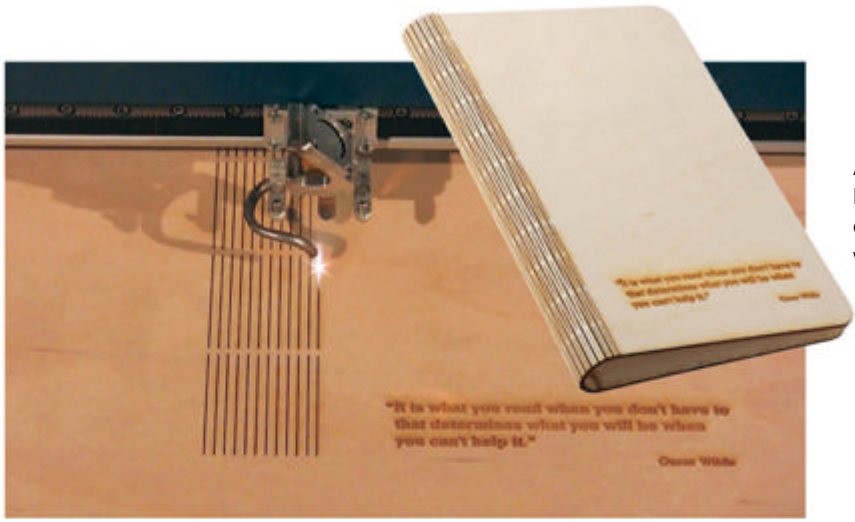
• To generate a fully three-dimensional drawing of your project, you'll need to use a CAD program with 3-D capabilities. While there are plenty of pricey programs used by professional industrial designers, such as AutoCAD or SolidWorks, you can get excellent results using "SketchUp Make," a free program that works with PCs or Macs. Drawing an object in three dimensions takes a bit of getting used to, but SketchUp has some excellent online tutorial videos that teach all the necessary skills. Once you've got the hang of it, you may wonder how you ever designed a piece of furniture, such as a bookcase, chair or desk, without rendering and examining it first in 3-D (see top illustration, above).

• If you're aiming to remodel your kitchen or bathroom, add a deck or some other home improvement project, a home design program, such as HGTV Ultimate Home Design, can help you quickly create a design, then visualize it in photorealistic 3-D. Instead of making a drawing one line or shape at a time, designs are created by using a "wizard" function that takes you through the design process step-by-step, or by "dragging and dropping" elements into your plan from an extensive library of forms, such as cabinets, furniture, appliances, lighting fixtures, etc. (see bottom illustration, above).

Expanding a Computer's Woodworking Savvy

Besides using a computer to create designs, drawings and plans, or to run computerized machines in the shop, there are other ways to put your laptop or tablet to work in making your woodworking hobby or business easier and more enjoyable.

- Store tool manuals
- Keep track of inventory
- Share your work and ideas
- Read magazines or books
- Get online plans
- Get new tool information
- Check user reviews
- Expand your knowledge
- Solve problems
- Purchase products



A powerful computer-controlled laser machine can cut out and engrave even the most intricate wooden parts with great precision.

• If you're a professional cabinetmaker or kitchen builder, a comprehensive (and expensive!) cabinetmaking program, such as CabinetPro or Cabinet Vision can help your business with everything from creating shop drawings and 3-D presentation graphics to generating cut lists, bills of materials, pricing and bidding reports, and even code for running CNC machines that cut out and shape your parts.

Woodworking Programs

Besides CAD software, there are literally hundreds of programs useful to small-shop woodworkers. Websites offer dozens of links to programs like compound angle calculators, dovetail angle and layout calculators, and more. On the technical side, there are free calculators for lumber shrinkage, board feet, log or lumber volume and weight. Another handy online "wizard" helps you determine where to clamp your router guide fence when routing grooves, dadoes or flutes. Having trouble with the rise and run of stairs (straight or spiral), baluster spacing (decks or upper landings) or deck design and layout? There's an online wizard for that, too!

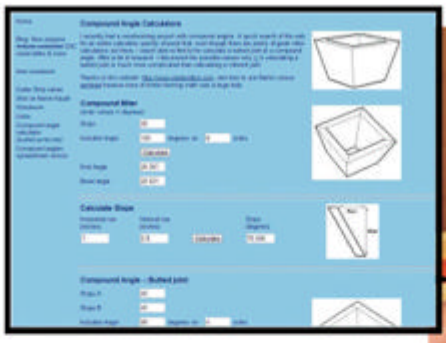
CNC Laser Engraving

If you're tired of cutting out intricate parts using a scroll saw or jigsaw, having your parts laser cut is an increasingly practical option. While few woodworkers have the budget to purchase their own laser machines (prices start in the thousands), there are online companies you can use to cut out your parts using a powerful CNC-guided laser machine. Some community workshops may have a laser that you can rent by the hour as well. Laser machines cut with such precision that they're superb for creating intricate parts with complex shapes or parts that require a high degree of accuracy. Laser cutting can even create flexible hinges (see book cover above) or interlocking joineries that allow entire projects to be assembled with only a tiny bit of glue: for example, toys, games, boxes, models or even musical instruments.

By using a less powerful laser beam, designs, patterns or even photographs can be burned into the surface of the wood, a process known as laser engraving.

Laser cutting and engraving can be done on a wide range of solid woods and wood materials, like hardwood-faced plywoods, MDF (regular and veneered) and melamine. On these materials, the laser leaves a dark cut edge — a result of the laser actually burning a thin kerf through the stock. Laser cutting or engraving can also be done on plastics, paper and cardboard, leather, cloth and even some metals, including aluminum and steel.

If you have a project that seems a good fit for laser-cut parts, one online vendor I've found, Ponoko, makes it very easy to upload computer files via the Internet for parts up to about 1/4" thick and 12 x 24 inches in size. For thicker and/or larger parts, you'll need to use an industrial laser cutting service such as Advanced Laser Cutting Technologies or create parts using CNC routing methods, described in the following section. After you've designed your parts with a CAD program (see the CAD section), be sure to save them as vector graphics files (.dwg, .dxf, .ai or .cdr). This kind of file is needed in order to run the laser machine. (Epilog Laser's "Sample Club" has some great examples of projects designed specifically for a laser machine.) Multiple parts can be nested on a single sheet of material, to create less waste. If you've created your part designs in a paint or photo program, you'll need to convert the resulting raster image file (bitmap, jpeg or similar) to a



Many useful computer programs for woodworking are freely available on the Internet. Two examples are the router fence distance calculator (at right) and compound angle cutting calculator (above).

vector graphic file before uploading it (laser engraving can often be done directly from raster files). Ponoko's site has instructions on how to convert and submit your files so they'll be ready to use, and even has links for free raster-to-vector conversion programs.

It's worth noting that some companies, including Ponoko, offer 3-D printing services. The process takes a three-dimensional design created with a CAD program and turns it into a physical object using a special 3-D printer that builds the part up by bonding ("printing") thin layers together, one at a time. The process can only be done with plastic, ceramics and some metals. But it could be used to create custom hardware, such as drawer pulls, or decorative details for your wood project.

Small Shop CNC Routers

Anyone who has ever attended a major woodworking show has seen them: humongous computer numerically controlled (CNC) routers as big as a small house, robotically dancing at breakneck speeds as they create complex parts from vacuum-clamped panels. Although these computerized giants don't have a place in the home workshop, the same technologies that make them so valuable in industry are now found in dozens of small-shop-sized CNCs that are practical and even affordable.

What is a CNC router? Basically, it's an automated shaping machine run by a computerized controller. A router is mounted to a two-part sliding fixture that uses stepper motors (a special kind of motor with a precisely controlled rotation) to accurately move the router above a base table where the workpiece is securely clamped. Although there are industrial CNCs with 6-axis capabilities, smaller models are typically three-axis machines. This allows the router and bit to cut in any combination of side-to-side, back-and-forth and up-and-down motions. The path of the router is determined by a computer programming language that tells the stepper motors which way to move the router and how fast. Fitted with the right bit, a CNC router can cut out flat or 3-D parts, shape edges and surfaces, bore holes, cut joinery and inlays, and even create intricate carvings and fretwork.

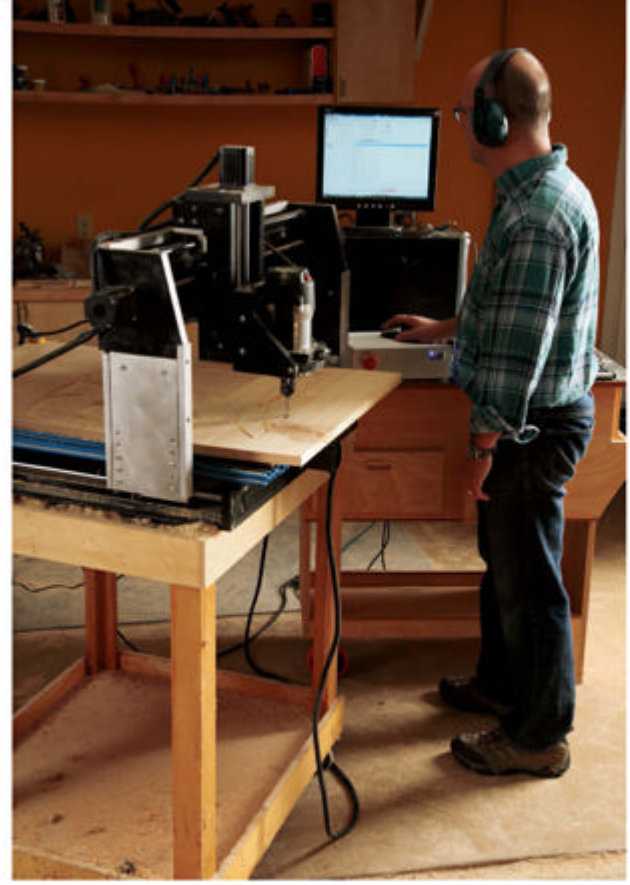
These machines are useful for producing all kinds of wooden items, from decorative plaques and lettered signs to shaped doors and drawers to architectural details to all manner of parts for furniture, toys, clocks, lamps, etc. (see

Apps for Tablets and Smartphones

Smartphones and tablets are portable and less susceptible to damage from fine dust. Coupled with the right application, they are very handy for woodshop tasks. There are scores of apps designed to tackle woodworking or home improvement tasks. I've used them successfully for the following functions:

- Check for level or plumb
- Identify wood species
- Lumber grading tables
- Board foot calculator
- Cut crown molding
- Screw and nail sizes
- Lumber dimensions
- Metric/fractions calculator
- Share furniture designs
- Cut list program
- Joint types

A desktop CNC router can easily cut out all the parts needed for building this handsome butler tray.



butler tray photo, above). Once a CNC program is created, it can be run over and over again, which makes these machines great for creating multiple identical parts for all kinds of wood production items: clocks, magazine racks, trays, you name it. Although they represent a substantial investment both in money (a larger model can run $4,000 or more) and in the time it takes to learn and operate, a CNC router could be an indispensable tool for a full-time or part-time woodworking business.

CarveWright CNC Router is an example of the mid-sized home shop CNC machines.

Small-shop CNCs come in many different sizes and configurations, each best suited to a particular range of applications. The smallest, least expensive machines, such as the Click-N-Carve, are designed primarily for engraving small plaques and pictures. This small, microwave-sized machine connects to a computer and uses software that translates an uploaded photograph into a shallow relief carving created with its built-in 30-watt router. Slightly larger in size and capacity, CNC routers like the CarveWright™ are capable of cutting out, shaping and carving moderate-sized parts: signs, door and drawer panels, etc. (photo at left). Machines like this are simple to operate using the included software.

Larger in size and capacity, desktop-style CNC routers, such as the General iCarver, mount atop a bench or stand and can handle solid wood or panel stock large enough for full-sized furniture and cabinet parts. For example, another desktop model, the CNC Shark HD 2.0 (photo, above) handles workpieces up to 36" long, 28½" wide and 5" thick. In lieu of a small built-in router used by smaller CNC routers, many desktop models like the Shark can run a more powerful router and make use of 1/2"-shank bits. A bigger router allows the use of larger, longer bits and faster cutting speeds.

The software used to actually run a CNC router varies between different machine makes and models. Most come with all the basic software necessary to both design your project and generate the codes that determine the router's tool path — the sequence of motions the router takes as the bit cuts the part. There are also additional CNC routing programs, many of which are specialized for a particular task: for example, transforming a photograph into a relief carving.

Sandor Nagyszalanczy is a contributing editor to Woodworker's Journal.

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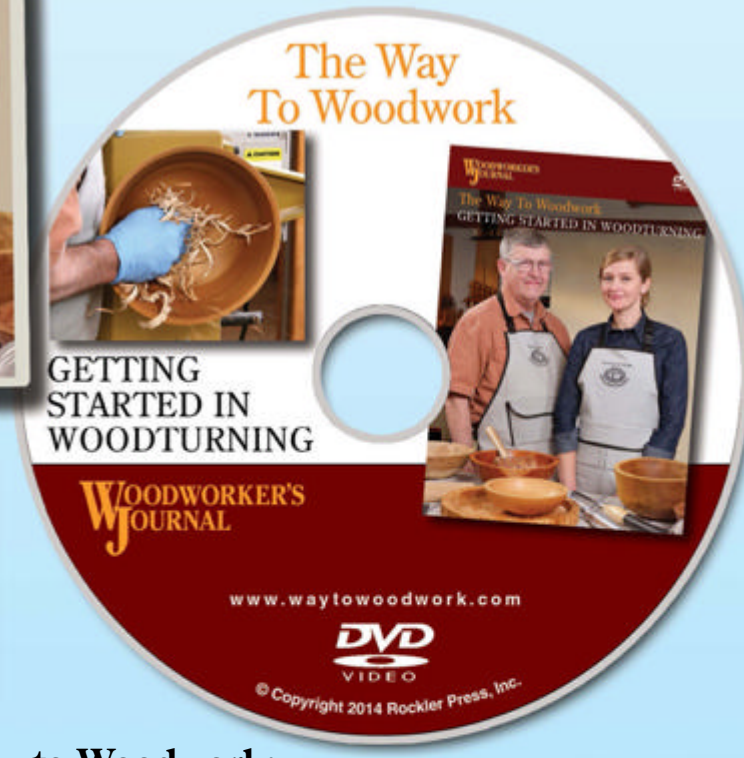

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Trapped Wedge Layout Gauge

THIS MARKING GAUGE FEATURES A KNIFE CUTTER THAT SCRIBES RAZOR-THIN LAYOUT LINES EITHER WITH OR ACROSS THE GRAIN.

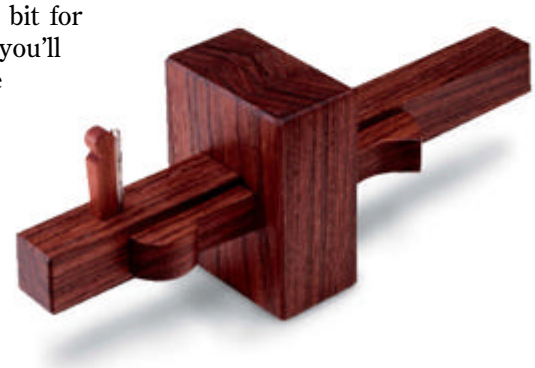
Half the challenge of cutting tight dovetail or mortise-and-tenon joints is getting them laid out precisely. A standard marking gauge featuring a sharp pin for a marker does a fine job scribing lines that follow the grain, but it tends to tear the wood when going across the grain. A knife tip makes a cleaner line than a pin on cross grain; it cleanly severs the wood fibers to establish a precise shoulder, which helps guide a chisel or saw during the joint-cutting process.

Besides the knife cutter, this gauge features a trapped wedge, which allows for quick, one-handed adjustments and eliminates the need for special hardware. Many hand tools constructed 150 years ago, when hardware was costly and more difficult to come by, utilized the trapped wedge.

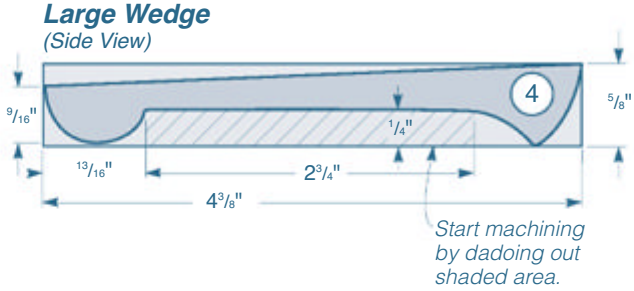
Traditionally, rosewood is the wood of choice for gauges of this type. This project requires less than one board foot of 3/4" stock. Buy a 1/4" spade bit for the knife stock, which you'll regrind to achieve the correct edge.

Start Your Cutting

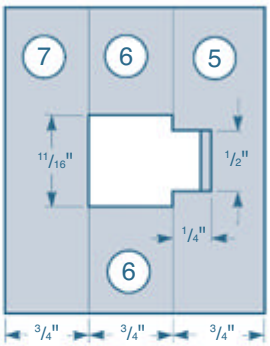
It's always safer to cut smaller pieces from larger ones so begin making your cutting gauge by ripping a slice of rosewood for the splines (pieces 1). These will eventually slip into a saw blade kerf, so cut a saw groove in some scrap to test the fit. Next, rip a 1/4"-thick by 8"-long strip that will be used later for the beam insert and



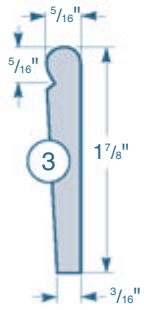
Large Wedge
(Side View)



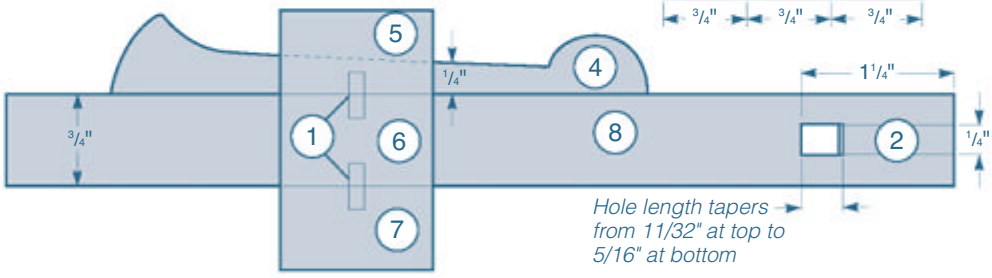
Head Assembly
(Front View)



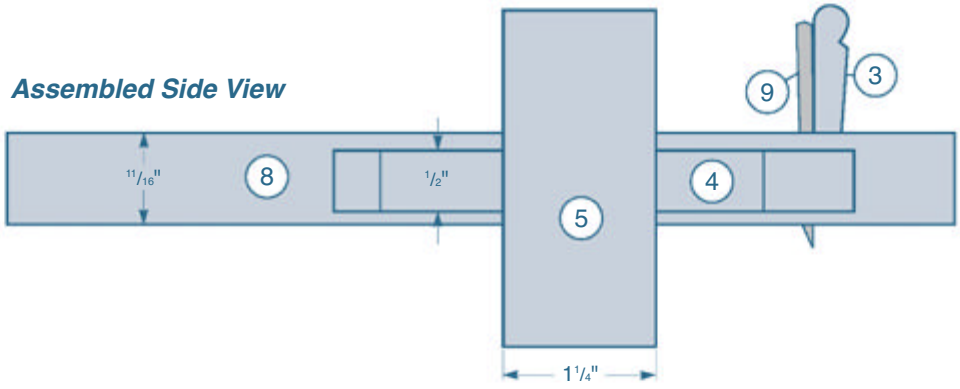
Small Wedge
(Side View)

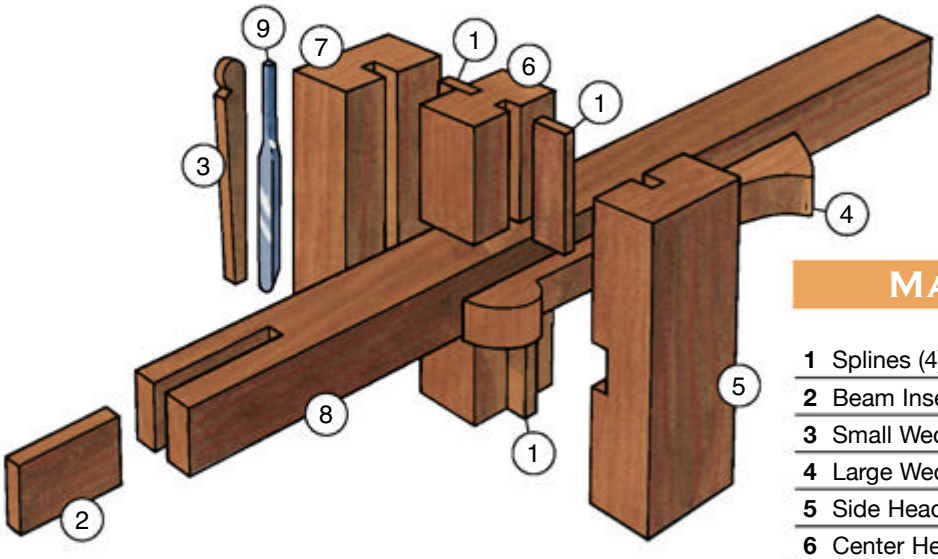


Assembled Top View



Assembled Side View





Material List

		T x W x L
1	Splines (4)	1/8" x 3/8" x 1 1/16"
2	Beam Insert (1)	1/4" x 3/4" x 4"
3	Small Wedge (1)	1/4" x 5/16" x 4"
4	Large Wedge (1)	1/2" x 3/4" x 4 3/8"
5	Side Head (1)	3/4" x 1 1/4" x 2 3/4"
6	Center Heads (2)	3/4" x 1 1/4" x 1"
7	Side Head (1)	3/4" x 1 1/4" x 2 3/4"
8	Beam (1)	3/4" x 11/16" x 8"
9	Cutter (1)	1/4" Spade bit

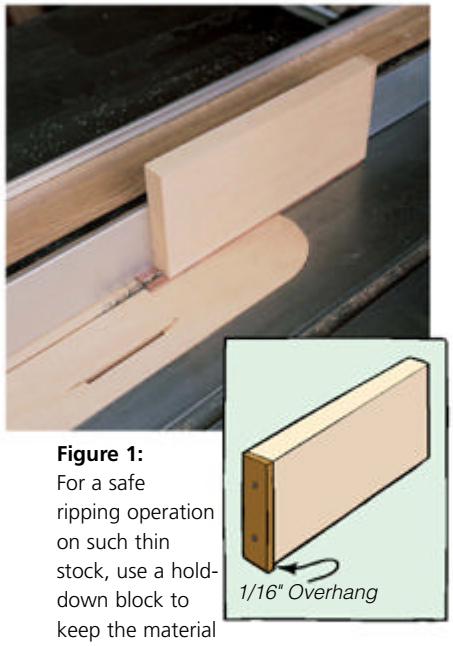


Figure 1: For a safe ripping operation on such thin stock, use a hold-down block to keep the material pressed tightly to the saw table throughout the cut.

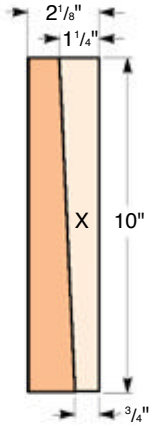


Figure 2: Begin making the jig for cutting a tapered dado by laying out a 1:20 slope on a 3/4" x 2¼"x 10" piece of scrap wood, then label the measured wedge with an "X".

Figure 3: Jig for making the tapered dado.

the small wedge (pieces 2 and 3), and slice a 1/2"-thick strip for the large wedge (piece 4). Sand off the saw marks and cut the splines and large wedge to length.

Cut the beam (piece 8) so that its width and thickness are unequal. This may seem odd, but through experience—meaning goof-ups—we've learned to avoid the age-old headache of fitting parts together the wrong way. By cutting the beam in this manner it will fit into the gauge head correctly every time. Rip the beam to size, then rip a 1¼"-wide piece for the parts that make up the head assembly (pieces 5, 6 and 7). Trim all the pieces 1/4" longer than their finished sizes.

Arrange the head pieces for assembly, matching their grain patterns so they appear to be one piece, and mark the front face of the assembly so you can reorder it again later. Next, separate the pieces and rip a 3/16"-deep groove in the center of each adjoining edge for inserting the splines. For perfect alignment, be sure to always run the front face of each piece against the saw fence during these cuts.

Ripping the splines to their final size requires a special hold-down block. Cut a block measuring 3/4" x 4" x 9", and screw a thin, narrow piece to its back end as shown in Figure 1, left. Set the blade height at 3/8" and rip your spline, using the block to hold it tightly to the table. Next, crosscut the strip into four segments (pieces 1) and check their fit in the head piece grooves you just made.

Cutting the Head Dado

The bottom of the dado in the side head (piece 5) is tapered to fit the large wedge. The tapered dado jig for making the cuts is built from softwood scraps. First, draw the pitch for the wedge taper, then mark this measured wedge with an "X" (see Figure 2). Next, cut a 1/4" x 1½" x 12" piece of plywood and nail it to the wedge stock so it's aligned with the pitch line and covering the side marked with the "X". With your fence set at 1½", rip the wedge stock while the plywood rides against the fence, as shown in Figure 3. Trim the wedge ends so they're identical. Complete the jig by nailing the wedges to a 3/4" x 3½" x 14" board (see Figure 4), and nail a fence block on top of the wedges.

To use your tapered dado jig, just raise your table saw blade 1" and set the fence 1¼" away. Push the jig into the blade until the center of the blade just passes under the front of the fence block. At this point, clamp a stop to the saw fence in front of the jig, as shown in Figure 4. Draw a line on the

front edge of the fence block 1/4" from its bottom and raise the saw blade to hit the line.

Make your cut by placing the side head (piece 5) on the jig with its marked front facing the fence block and one end bearing against the saw fence. Make your first pass, then continue moving the saw fence to make several more passes until the dado is 1/2" wide. Be sure to fine-tune the last pass so the dado fits the large wedge precisely, then smooth the dado's angled bottom with a file.

Assembling the Head Pieces

After a careful sanding, dry assemble the head pieces and splines around it, sanding the 3/4" dimension of the beam, if necessary, so it slides through the opening.

To prevent the beam from bonding to the head, coat its first 2" with paraffin wax. Now glue the head and spline pieces together and, while pinching the assembly with your fingers, quickly clean out the excess glue in the opening. Slip the waxed end of the beam into the head assembly and clamp everything tight in both directions (top to bottom and side to side). Later, when the glue has dried, you can sand the beam's 1$\frac{1}{16}$" dimension so it slides in the opening easily, trim the head to final size and chamfer all its edges and corners.

Making the Trapped Wedge

Begin making the trapped wedge (piece 4) by ripping the stock you cut earlier to 5/8" wide and cutting a dado as shown in the *Large Wedge Side View* on page 89. Once the dado is cut, remove one of the wedges from the tapered dado jig and nail a stop to its wide end to make a tapering jig for the large wedge (see Figure 5). Set the wedge against the taper jig and rip the piece, splitting the lead corner with the blade. For safety, use scrap wood to press down on the wedge as you cut. Now center the wedge in the dado to see if its back edge is flush with the shoulder of the larger hole. If the fit isn't right, continue trimming the wedge in very small increments, then shape the ends of the wedge with a coping saw and a file.

Cutting the Beam Slot

The hole in the beam that holds the knife and small wedge is tapered on its forward edge. It sounds unorthodox, but this is easily done on the table saw. Make the jig shown in Figure 6, then use it to cut a 1/4"-wide by 1¼"-deep slot in the end of the beam (remember, the beam isn't square, so be sure to cut into its wider edge).

Earlier you cut a 1/4"-thick strip for making the small wedge and the beam insert. To cut the strip in half, set your tapering jig against the table saw's

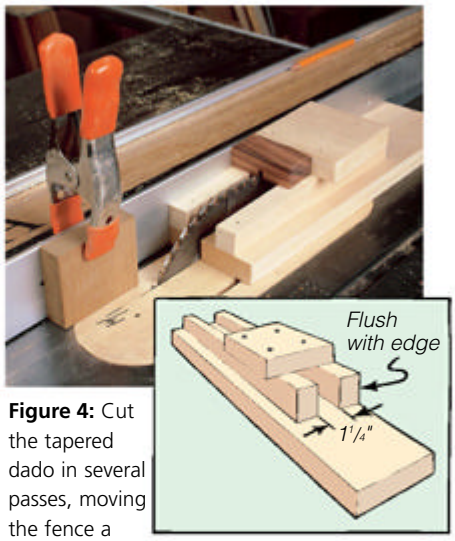


Figure 4: Cut the tapered dado in several passes, moving the fence a little for each pass.

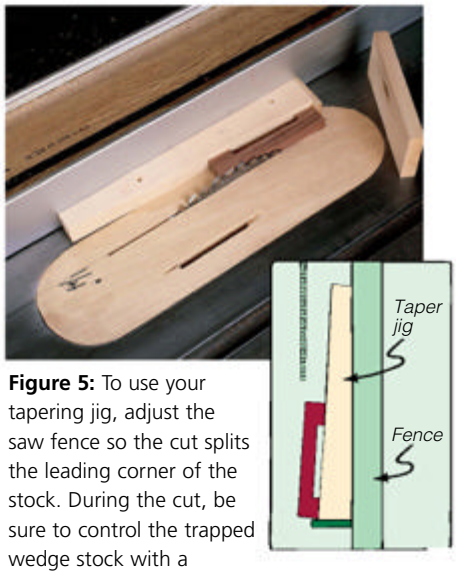


Figure 5: To use your tapering jig, adjust the saw fence so the cut splits the leading corner of the stock. During the cut, be sure to control the trapped wedge stock with a narrow hold-down block.

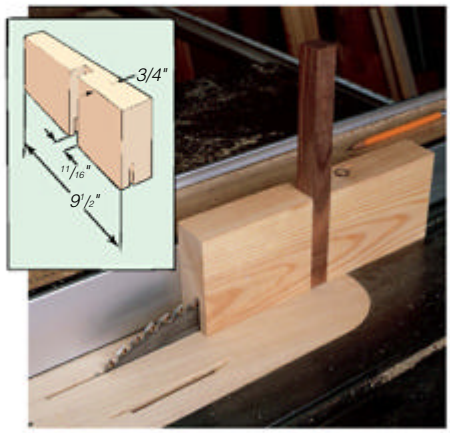


Figure 6: Cutting a 1¼"-deep slot for the beam insert is safe and easy using this jig.

miter gauge, then place the strip against the jig. The resulting angled cut is just what you need for the end of the beam insert. Sand one of the pieces to fit into the slot in the beam, then glue it into place with the angled end pointing into the beam and leaving a 5/16"-long hole on the bottom side for the cutter and the small wedge. Trim off the excess when it's dry, and chamfer the ends of the beam.

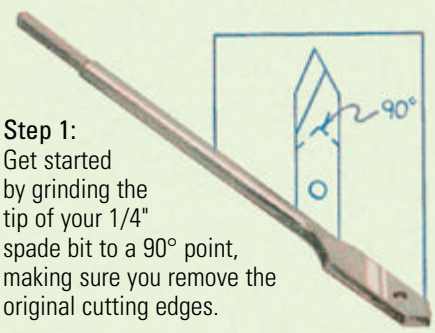
A stout knife blade (piece 9) is easy to resharpen, and we've found that regrinding a 1/4" spade drill bit is ideal (see *sidebar,* below). In use, the knife's bevel should always face the waste side of the work, leaving a square shoulder on the proper side of the cut.

Use the remaining 1/4"-thick piece for the small wedge (piece 3). First taper one edge on the table saw with the tapering jig, then plane the piece to width and cut it to length (see *Small Wedge* drawing on page 89). Shape the top of the wedge with a file and smooth any saw marks.

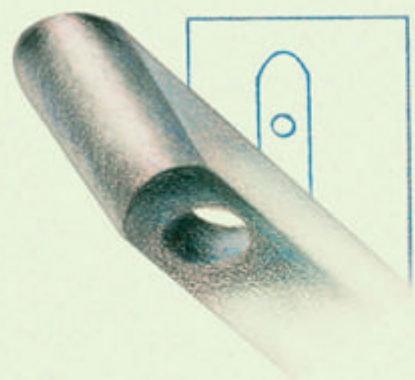
Final Assembly and Finishing

Slip the cutter into the beam hole and install the small wedge. Trim the end of the wedge so it's flush with the bottom of the beam, then pull it back out to chamfer the end with a file. Coat the gauge with a penetrating oil-type finish and put more wax on the beam so it slides easily. You'll quickly find that the trapped wedge locks with slight hand pressure to maintain the exact position you set it at.

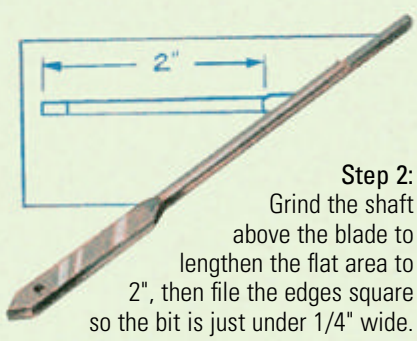
Four Easy Steps to Grind the Cutter



Step 1: Get started by grinding the tip of your 1/4" spade bit to a 90° point, making sure you remove the original cutting edges.



Step 3: Hone the back of the blade on your sharpening stones, then, while rounding the end into a fingernail shape, grind a 25° bevel.



Step 2: Grind the shaft above the blade to lengthen the flat area to 2", then file the edges square so the bit is just under 1/4" wide.

Step 4: Hone the bevel with a slipstone and finish up by hacksawing the cutter off the shaft 2" from the tip.

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The Way To Woodwork: Mastering the Table Saw

Learn to safely and confidently operate the most important tool in your workshop with the latest installment in *The Way To Woodwork* series: *Mastering the Table Saw*. Our experts teach everything, from the basics of ripping and crosscutting, working up to more advanced techniques. You'll also discover how jigs add versatility, safety and accuracy to your table saw. Expert or rookie, this DVD has something for every woodworker.

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The All-Purpose Shop Table

One sheet of plywood is all it takes to expand your bench space.

You may hear a different story about the brass at the Pentagon, but our guys in uniform sure know how to squeeze a dime for all it's worth. As a GI during World War II, author Keith Hettinger helped build thousands of these all-purpose tables at bases throughout the south Pacific. The design calls for only one sheet of 4 x 8 plywood and, judging from the plywood cutting diagram on the next page, every inch gets used short of the sawdust left on the ground.

Step 1: After cutting the plywood into sections (see *Plywood Cutting Diagram*, next page), follow the layout to cut the individual pieces to size.

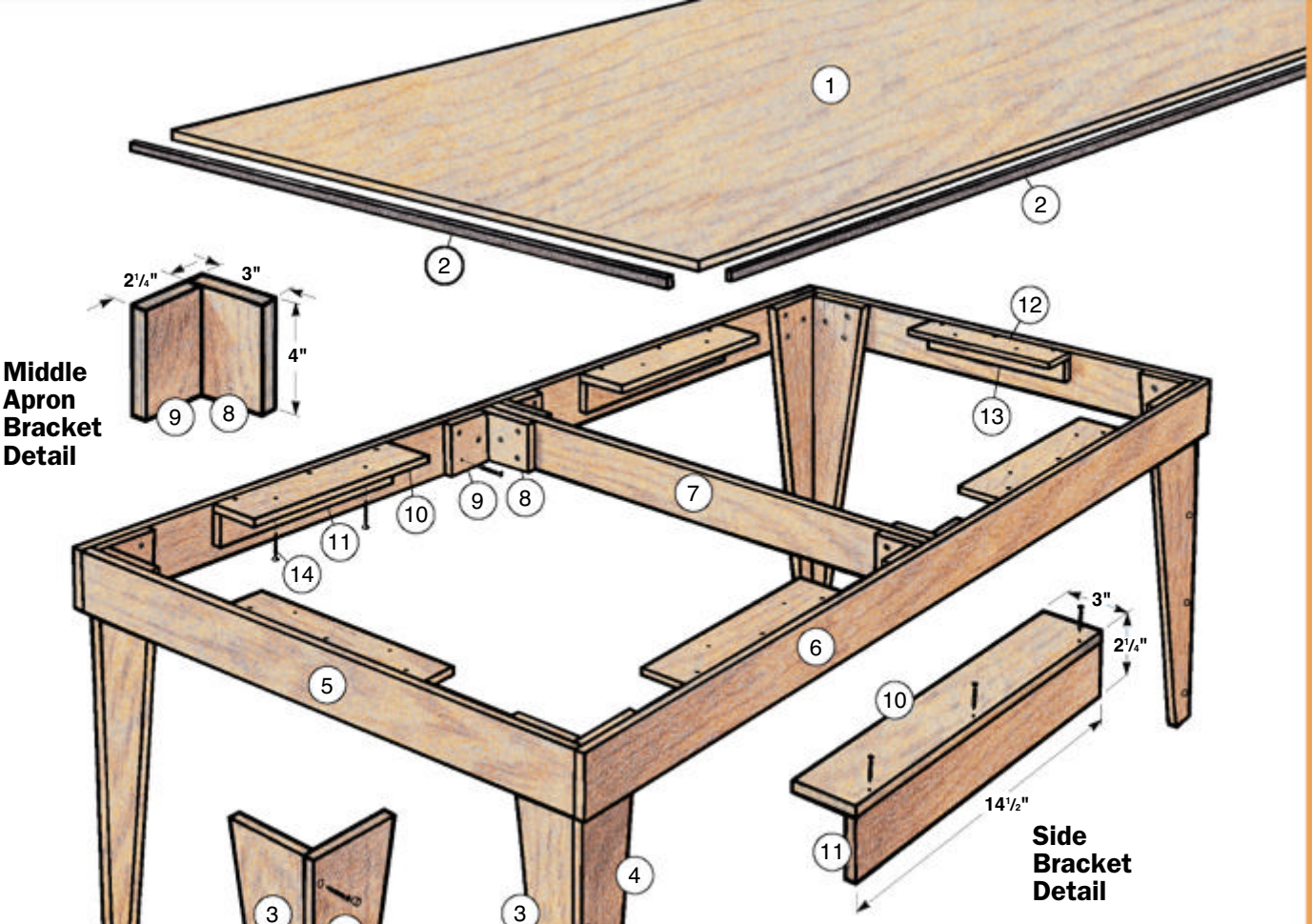
Step 2: Make a tapering jig from scrap wood, as shown in the *Taper Jig Layout* drawing on the next page, and rip the leg panels to size and shape.

Step 3: Drill counterbored pilot holes in the wider leg pieces, then glue and screw the legs into four corner brackets. Glue plugs into the counterbores.

Step 4: Glue and screw the aprons to the leg brackets, making sure to secure the end aprons first to get the correct overlap at the corners.

Step 5: Assemble the pieces for all the support brackets and install the middle apron. Next, mount the remaining brackets to the aprons with screws.

Step 6: Band the top with walnut and lay it on your workbench. Position the base on the top, check for squareness and screw the base to the top. Sand and finish with paint or varnish.



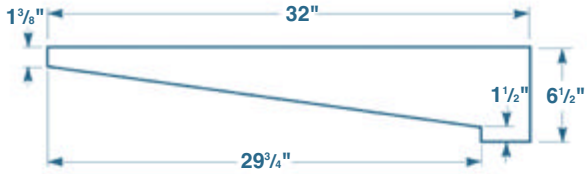
Middle Apron Bracket Detail

Leg Bracket Detail

Side Bracket Detail

Note: piece 3 tapers from 4¼" to 3/4", and piece 4 tapers from 5" to 1½".

Taper Jig Layout

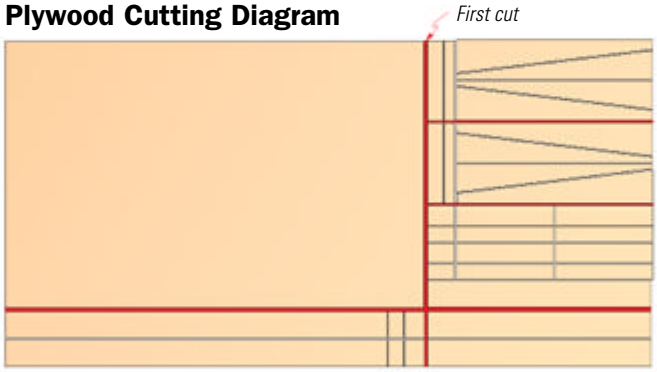


Material List

		T x W x L
1	Top (1)	3/4" x 39¾" x 62½"
2	Walnut Banding*	1/2" x 3/4" x 22'
3	Legs (4)	3/4" x 4¼" x 29¼"
4	Legs (4)	3/4" x 5" x 29¼"
5	End Aprons (2)	3/4" x 4" x 33⅜"
6	Side Aprons (2)	3/4" x 4" x 57"
7	Middle Apron (1)	3/4" x 4" x 33⅜"
8	Middle Apron Supports (4)	3/4" x 3" x 4"
9	Middle Apron Supports (4)	3/4" x 2¼" x 4"
10	Side Supports (4)	3/4" x 3" x 14½"
11	Side Supports (4)	3/4" x 2¼" x 14½"
12	End Supports (2)	3/4" x 2⅝" x 12"
13	End Supports (2)	3/4" x 1⅝" x 12"
14	Screws (100)	#8-1¼"
15	Oak Plugs (16)	3/8" Dia.

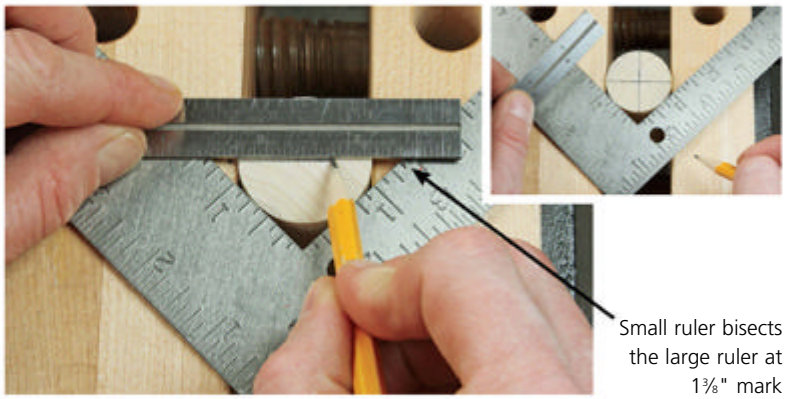
**Optional*

Plywood Cutting Diagram



Cut your 4 x 8 sheet of plywood into manageable sections following the red lines, beginning with the line labeled first cut.

Tricks of the Trade



Centering a Circle with a Square

There's an easy way to find the centerpoint of a dowel or other solid cylinder. Measure the dowel's diameter, and clamp it in a bench vise so just 1/8" or so sticks above it. Set the inside corner of a carpenter's square against the dowel. Now take a short straightedge and lay it across the dowel, aligning its edge with the marks on each leg of the square that equal the dowel's diameter — in the example shown here, 1⅜" for a 1⅜"-diameter dowel. Draw a line to bisect the circle. Then unclamp and turn the dowel 90 degrees, and repeat the marking process to draw a second diameter line. Their intersection marks the centerpoint.

$5 Assembly Squares

Here's a surprising source for inexpensive assembly squares: the building hardware section of your home center. There, look for Simpson Strong-Tie® CF-R concrete form angle brackets. These 6" galvanized brackets form a perfect square corner, and their 16-gauge steel is plenty sturdy for clamping and assembly jobs. At around $5 apiece, they could be a great value to woodworkers.

Garage Door Draft Stopper

No matter how well-insulated your garage workshop is, chances are good that air leaks around the garage door, so you lose heating or cooling efficiency. But a couple of toggle clamps mounted at the sides of the door can help hold it firmly against the weather seals at the edges. Mount the clamps on wooden blocks sized to clear the door's roller tracks. You don't need a lot of clamping pressure to create a good seal. Disengage the clamps before opening the door, of course; the toggle clamps will make this easy.

Clamp Keeps Brads in Line

When assembling cabinets and other projects, you can use a straightedge to help position your brad nailer for securing the joints. Set and clamp the straightedge about 1/8" off the centerline of the joint to account for the bumper on the tip of the gun, then butt the nailer's tip against the straightedge before squeezing the trigger. It's an effective way to center the brads and keep them neatly lined up while also speeding up your nailing process.

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Tricks of the Trade *(continued)*

Hammer into Rubber Mallet for Pocket Change
Here's a trick one of our readers has used for more than a decade to turn a claw hammer into his version of a rubber mallet. Just fit a white rubber chair leg protector over the hammerhead. You can find them in four-packs at any hardware or discount store for just a few dollars. The rubber cap pushes on snugly so it won't fall off. It works great, and the hammer won't mar your workpieces.

T-track Compass
A set of nice trammel points or an oversized compass can be quite expensive for the hobbyist woodworker. But, here's all you need to make a big compass from common materials: a length of aluminum T-track, two 1½"-long T-bolts and knobs, two 1 x 2" blocks of scrap, a pencil and a screw. As you can see, the bolts and knobs hold the blocks at any position along the T-track, so the compass is completely adjustable. Drive the screw through one block to serve as the pivot point, and drill a hole through the other block to hold the pencil. A band sawn slit up to the pencil hole enables the bolt and knob to grip the pencil securely. Here's a sturdy compass that will only be limited by the length of your T-track.

Leave Sanding Discs in the Dust
Removing a 12" adhesive-backed sanding disc from your disc sander can be tough. Even when the disc is spent, the adhesive wants to keep sticking as you peel the disc off of the plate. Here's a new approach: one of our readers dusted the backing with baby powder while using a putty knife to pry the disc off. The powder adhered to the adhesive to prevent it from sticking again, and that really helped. Make sure to vacuum the plate clean again before you install the new disc to keep it from coming loose.

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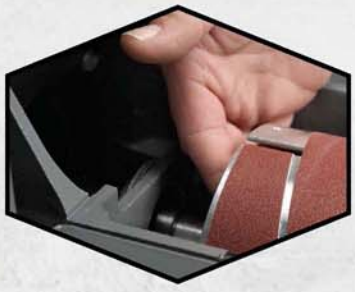

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